THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 38. Thursday, March 1, 1928. No. 602.

PUBLISHED WEEKLY

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telephone: Gerrard 3961 (4 lines).
Telegraphic Address: "Zacatecas, Rand, London."

Contents.

	PAGE
International Testing	143
How is Trade?	143
Programme for the Philadelphia Convention of the A.F.A.	144
Gas at the British Industries Fair	144
East Midlands Foundrymen	144
American Equipment Manufacturers' Association	144
Sea Sand Cores	145
Institute of British Foundrymen	146
Lancashire Junior Foundrymen's Social Evening	146
Correspondence	146
Random Shots	146
Age-Hardening of Alloys	147
The Inspection Bugbear	148
American Duty on Pig-Iron	148
The Selection of Pig-Irons and Similar Raw Materials Used in the Manufacture of Grey-Iron Castings	149
An Example of Modern Sand-Blasting Equipment	152
Common Defects in Brass	152
Foundry Pig-Iron	153
Improving the Small Business	155
British Industries Fair—Birmingham Section	156
Foundry Purchasing—XXI	156
The Continental Steel Trust	156
Trade Talk	158
Contracts Open	158
Personal	158
Company Meetings	158
Iron and Steel Markets	160
Publications Received	160
Record Breaking and Engine Parts	160

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1927-28:
John T. Goodwin, M.B.E., M.I.Mech.E., The Red House, Old Whittington, Chesterfield.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office, 49, Wellington Street, London, W.C.2.
Birmingham: F. K. Heath, 24, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 26, Castlewood Road, Pulwood, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: H. Stead, 1st/36, Cheetham Hill Road, Stalybridge, Cheshire.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
Newcastle-on-Tyne: P. Sanderson, 10, Westgate Road, Newcastle-on-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire Branch: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.
Middlesbrough: N. D. Ridsdale, 3, Wilson Street, Middlesbrough.

Foundry Trades Equipment & Supplies Association.

President: Vincent C. Faulkner, 49, Wellington Street, London, W.C.2.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Welsh Engineers' and Founders' Association.

Secretary: P. J. Griffiths, 20, Fisher Street, Swansea

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. are at:—
24, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1885. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332.*)

Forthcoming Events.

MARCH 5.

Society of Chemical Industry (London Section):—Ordinary meeting. "Syntheses under High Pressure," Paper by Prof. G. T. Morgan, F.R.S., R. Taylor, M.A., B.Sc., and T. J. Hedley, A.M.I.Chem.E.

Institute of Metals (Sheffield Local Section):—Conjoint meeting with kindred societies at the University. Paper by Dr. S. Z. de Ferranti on "Electricity in the Service of Man."

MARCH 7 and 8.

Institute of Metals:—Annual general meeting and dinner in London.

MARCH 8-9.

Institution of Chemical Engineers:—Conference, sixth annual corporate meeting, and annual dinner at the New Princes' Restaurant, London, S.W.1.

MARCH 9.

Institute of Metals (Sheffield Local Section):—Meeting at the University. "Special Alloys in Relation to the Corrosion Problem," Paper by W. R. Barclay, O.B.E.

Institute of British Foundrymen.

MARCH 7.

Institution of Heating and Ventilating Engineers:—Sessional meeting in London. "The Manufacture of Malleable Iron Pipe Fittings," Paper by H. R. Hiscott.

MARCH 10.

Scottish Branch:—Ordinary meeting at Glasgow. "Scottish Moulding Sands." Paper by F. Hudson.

MARCH 13.

Lancashire Branch (Burnley Section):—Ordinary meeting at Burnley. "Foundry Conditions," Paper by W. H. Meadowcroft.

International Testing.

We referred at the time to a conference which was held in Amsterdam in September last to consider the re-establishment of machinery for the international interchange of opinion on questions concerned with materials and the testing of materials, and consequently to consider further the possibility of reviving the pre-war International Association for Testing Materials. Decided views were expressed on the occasion of this conference in favour of the re-establishment of some such means of contact, but it was felt that although this might be done by the formation of an international association, it should be constructed on slightly different lines from its pre-war prototype.

The proposed association has now been reconstituted on the following lines. A conference is to be held at intervals of not less than three and not more than five years. There is to be no permanent secretariat, but the secretary for the time being is to be located in the city chosen for the next conference. It has further been decided that the next conference shall take place in Zurich in 1931. The new organisation thus consists primarily of a series of linked and co-ordinated conferences.

Certain changes in the scope of the association have also been agreed upon. It is definitely stated that no attempt is to be made to deal with standard specifications—a matter which caused considerable difficulty before the war. It is gratifying to note that this change was secured by the united opinions of the American and British representatives. Moreover, the new association will apparently not confine its attention wholly to structural materials.

All technical and scientific associations concerned with materials will be invited to support the organisation by membership, for which individual members of such institutions will also be eligible. It is to be hoped that enough interest will be taken in this country to ensure an adequate and representative delegation at the next conference, as evidence is not lacking that the matter is arousing keen and active interest in other countries. We in Great Britain are unfortunately prone to take a somewhat insular view of general conferences held on the Continent, and this frequently prevents the formation of an adequate British delegation. Not only does this react unfavourably on our prestige on the Continent, but in the presence of a delegation that lacks status, dignity, or the weight of numbers, British views often go by default. At the Amsterdam conference the delegates from the United States were three or four times as numerous as our own.

It is some years since the founding industry as represented by the Institute of British Foundrymen began an arrangement to secure the same ends in its own field—namely, the exchange paper—but this does not absolve founders from all interest in the new movement. It might even be said that their foresight in the one case is a reason for expecting that they will lend an instructed and sympathetic support to the newer and wider organisation.

How is Trade?

Day after day we are greeted with the question of "How is the Foundry Trade?" and we confess that to give an intelligent answer is no easy matter. We refuse to be influenced by any one section such as pipes or rain-water goods, as we have long been convinced that no one section adequately represents the whole. There are so many axiomatic premises and fundamental factors that from their analysis it becomes increasingly difficult to give a rational assessment. To base it on pig-iron production, with reservations for steel production, cannot give a reliable answer on the common ground that both the steel and iron foundry industry are using indefinite quantities of steel and iron scrap. To insist that it follows the general trade of the country is probably true, though variables can and do creep in, as, for instance, a boom in engineering products influences casting output more than great activity in textiles. As indicating the general trend of trade, it is customary to examine (1) the unemployment returns, (2) coal output, (3) railway traffic returns, and (4) Board of Trade returns. The unemployment figures have been shown to be elusive and should only be considered in conjunction with the employment figures in insured trades. The coal-output figures are vitiated by the varying quantities which are exported, a factor which, allied with similar ones, naturally influences the traffic returns of the railway companies. In this latter case, too, an increasingly large number of firms are using road transport. Finally, the Board of Trade returns are reflective of manufacturing conditions of at least two months previously, as castings are not usually shipped in the rough.

Thus, though one may be cognisant of the trend of all four factors, it is still difficult to give a direct answer, and quite extraneous affairs may influence profoundly the corollary the questioner usually has in mind—that of forward buying. At the moment, rising internal prices on the Continent and the strike of Swedish iron-ore miners are combining to make conditions favourable for the Cleveland ironmasters to consider seriously the advisability of asking the foundry industry to pay more money for its pig-iron. The exact ascertainment of the state of trade in the foundry industry would indeed be of the greatest utility, but with the present organisation of the trade we can but make deductions from the heterogeneous mass of data available to us.

Programme for the Philadelphia Convention of the A.F.A.

The programme committee of the American Foundrymen's Association, in arranging for the programme of meetings for the thirty-second annual convention of the association at Philadelphia, May 14 to 18, announces the following tentative schedule of technical sessions:—

Monday, May 14.—Registration, committee meetings, and first session in cupola operation course.

Tuesday, May 15.—Morning, (1) Opening meeting and business session; (2) non-ferrous metals; (3) steel founding; (4) cast iron; and (afternoon) (5) foundry costs and second session in cupola operation course.

Wednesday, May 16.—(Morning), (6) Steel metallurgy; (7) cast iron; (8) round table talk on brass founding; and (afternoon), (9) foundry management, and (10) foundry coke specifications and third session in cupola operation course.

Thursday, May 17.—(Morning), (11) General foundry practice; (12) apprentice training; and (13) round table talk on malleable founding; and (afternoon), (14) sand control; fourth session cupola operation course.

Friday, May 18.—(Morning), (15) Materials handling, and (16) malleable founding.

The Papers for these meetings, while not all the sessions have been definitely arranged, show promise of being some of the best, as a group, ever secured for an A.F.A. meeting. The interests of all the four branches of the industry have been considered, and in addition the varied interests of the metallurgists, executive, shop manager, engineer and practical shop man have been met. A partial list of the Papers to be presented follows:—

"Furnace Refractories for Brass Foundries," by H. M. St. John, chief metallurgist, Detroit Lubricator Company, Detroit.

"Science in the Foundry," by E. F. Hess, metallurgist, Ohio Injector Company, Wadsworth, Ohio.

"Risers, Their Need and Feed," by R. R. Clarke, alloy foundry, General Electric Company, Erie, Pa.

"Variables in Steel Foundry Practice," by F. A. Melmoth, Thomas Firth & Sons, Limited, Sheffield; I.B.F. Exchange Paper.

"Economies in Oxy-Acetylene Cutting for Riser Removing," by G. O. Carter, Linde Air Products Company, 30, East Forty-second Street, New York.

"Sand Reclaiming in the Steel Foundry," by D. M. Scott, Gould Coupler Company, Depew, N.Y.

"Interdependence of Operating and Sales Departments in the Success of a Foundry," by K. V. Wheeler, Lebanon Steel Foundry, Lebanon, Pa.

"Theory of Cupola Operation in Relation to Practice," by R. B. Schaal, Roberts & Manders Stove Company, Hatboro, Pa.

"Automatic Blast Gate Control for the Cupola," by H. W. Crawford, General Electric Company, Schenectady, N.Y.

"Necessity for Creating a Casting Consciousness," by A. F. Jensen, Hanna Engineering Company, Chicago.

"The Schedule Fallacy," by J. J. Ewens, George H. Smith Company, Milwaukee.

"General Characteristics of Alloy Steel Castings," by J. W. Frank, Chicago Steel Foundry Company, Chicago.

"The Research Laboratory of the American Steel Foundries," by W. C. Hamilton, research director, American Steel Foundries, Indiana Harbour, Ind.

"Temperature Measurements of Molten Cast Iron," by H. T. Wensel and W. F. Roeser, United States Bureau of Standards, Washington.

"Influences of Carbon and Silicon Variations in Cast Iron," by D. G. Anderson and G. R. Bessmer, Western Electric Company, Chicago.

"Producing High-Strength Cast Iron," by John D. Miller, Cresson-Morris Company, Philadelphia.

"Basic Principles of Management in the Foundry," by J. D. Towne, Dayton, Ohio.

"Manganese Steel," by H. P. Evans, Pettibone-Mulliken Company, Chicago.

"Stabilising Labour and Cutting Cost by Horse Sense," by A. D. Lynch, Ohio Brass Company, Mansfield, Ohio.

"What Does the Buyer Expect for His Money?" by J. A. Marks, Packard Motor Car Company, Detroit.

"A Contribution to the Training of Labour and the Personnel of a Foundry," by A. Soupart, Director of Musée, Professional de l'Etat et des Ecoles Techniques de Morlanwetz; Exchange Paper of the Association Technique de Fonderie de Belgique.

"Heat Losses from a 75-Ton Hot Metal Car," by W. F. Roeser, United States Bureau of Standards, Washington.

"Surface Conditions of Castings as Affected by Core Sand Mixtures," by H. L. Campbell, University of Michigan, Ann Arbor, Mich.

"Testing Moulding Sands for Durability," by M. A. Blakey, International Harvester Company, Milwaukee.

"Sand Conservation and Control in a Grey Iron Jobbing Shop," by T. F. Kiley, Brown & Sharpe Manufacturing Company, Providence, R.I.

"Sand Control Methods in a Light Casting Foundry," by W. G. Reichert, Singer Manufacturing Company, Elizabeth-port, N.J.

"Materials Handling and Its Relationship to Building Plans," by E. F. Scott, Austin Company, Cleveland.

"Reducing Scrap in the Malleable Foundry," by R. A. Greene, Ohio Brass Company, Mansfield, Ohio.

This list of Papers will be supplemented by others and by reports of committees.

The technical sessions, scheduled for the mornings of the convention week, will be held in the meeting rooms of the Hotel Bellevue-Stratford, and the afternoon meetings, which are all of general interest, will be held in the meeting rooms of the Commercial Museum, which will house the foundry exhibit.

The Cupola Operation Course.

An innovation this year, to interest that large group of foundrymen, the practical men in cast-iron foundries operating and working with cupolas, will be the four-period cupola operation discussion course. These discussion groups will be held on each of the first four days of the meeting. The leaders each day are as follows:—

Monday, May 14, Dr. Richard Moldenke, "Principles Underlying Cupola Melting Processes"; Tuesday, May 15, E. J. Lowry, "Cupola Construction Details"; Wednesday, May 16, David McLain, "Cupola Charging Practice"; Thursday, May 17, H. W. Dietert, "Cupola Improvement."

Gas at the British Industries Fair.

For the first time there is a comprehensive display of gas equipment representative of the gas industry at the British Industries Fair at Birmingham. The exhibits of the British Commercial Gas Association and sixty manufacturers of gas plant and appliances occupy a space of no less than 16,000 sq. ft.

A fair amount of gas-works plant is shown, as well as many appliances for use in the factory, the institution and the home. The exhibits of gas cookers show signs of many improvements incorporated during the last few years—automatic control of heat in the oven, hot-plate burners which cannot become clogged, single oven-burners, and finally, an "all-enamel" finish. The castings of these cookers leave little to be desired. They are good examples of clean foundry work. Special gas-fire flues which are now taking the place of costly chimneys in many housing schemes are shown, together with gas fires which are beautiful in design, silent in action, and economical in gas consumption. The Cannon Iron Foundries, Limited, are showing some excellent cast-iron hollow-ware—saucepans, oval pots, round pots, tea kettles; export castings—negro pots, Danish pots, Dutch stoves, rice bowls; and cast-iron acid-resisting enamel-lined chemical plant—steam-jacketed pans, furnace boilers, filters, pipes and pans, and the like.

East Midlands Foundrymen.

Visit to Lead Works.

On the afternoon of February 11 the members of the East Midland Branch visited the works of Messrs. Cox Bros., Derby, where they inspected the plant where the various articles in the lead industry are manufactured for commercial purposes, which included sheet lead, white and red lead (whitening), white lead for decorative purposes, putty, white paint, gas piping, etc. The members were very interested in the various processes. In the making of sheet lead an ingot of approximately 12 tons is cast, and whilst in an heated state is passed over and through rollers until the desired thickness is acquired.

Much interest was shown in the making of the white and red lead by means of oxidation, also in the process of whitening where oak tan and acetic acid is used. The greater interest was shown in the making of lead piping, where the allotropic state of the metal makes it possible for it to be forced through dies of the required shape whilst in a solid state, the tinning of the piping being a dual operation.

At the conclusion of the visit the President, Mr. H. Pemberton, extended to the board of directors of Messrs. Cox Bros., Mr. Cope, the manager, and the staff, the thanks and appreciation of the members for the facilities they had given for the inspection of the works. This was seconded by Mr. S. H. Russell and carried unanimously. Mr. Cope, replying, remarked that the day of trade secrets had passed, and assured the members that it had been a pleasure to conduct the party round that they may see the methods employed in the manufacture of lead for commercial purposes.

American Equipment Manufacturers Association.

At the annual meeting of the Foundry Equipment Manufacturers' Association, in Cleveland, February 7, the following officers were elected for the ensuing year:—President, S. C. Vessy, W. W. Sly Manufacturing Company, Cleveland; vice-president, Henry W. Standart, Northern Engineering Works, Detroit. H. Cole Estep, Penton Building, Cleveland, was re-elected secretary-treasurer. Mr. Standart was also elected a director for the term ending February, 1931, together with A. F. Jensen, Hanna Engineering Works, Chicago. Mr. Vessy was re-elected a director. In addition to the foregoing, the board now includes T. W. Pangborn, Pangborn Corporation, Hagerstown, Md., past-president, and E. O. Beardsley, Beardsley & Piper Company, Chicago.

The report of the secretary-treasurer showed that the Association has reached a high point in number of members and in financial resources. The reports on business conditions showed that somewhat better conditions have prevailed since the first of the year. It was agreed to take steps to enlarge and amplify the statistical work of the Association.

Sentinel Wagon Works, Limited.—Mr. S. E. Alley, presiding at the eighth annual meeting, remarked that the net trading profit for the year, arrived at after meeting all charges and allowing for contingencies, was £41,124, and to it had to be added £1,058 brought forward, making a total disposable balance of £42,182. Of that the directors had applied £15,106 for depreciation of property, plant, and machinery, they had written £656 off patents, and £1,750 off the expenses of issuing new preference shares, reducing that item to £1,750. They would be asked later to approve a dividend of 7½ per cent. on the preference shares, of which an interim dividend up to June 30 had already been paid. The sum of £2,169 would be carried forward to the 1928 account. The railway department again last year showed a substantial gain in orders obtained. Railway orders were often placed towards the end of a year, and many were taken last year too late to affect profits. Railway officers were realising that in "Sentinel-Cammell" rail-cars and "Sentinel" locomotives they had vehicles which enabled them to make large economies.

Sea Sand Cores.

By "Sprig."

The presence of sea sand in the foundry to-day is a common sight, in fact those foundries not using it are behind the times. The writer takes his memory back nineteen years, and well remembers the difficulties then encountered, and the various mixtures of sands necessary to enable the fettler to get cores out of steam-jacketed pans, saddle-type boilers, radiators and the like, to say nothing of the great percentage of wasters caused through not being able to get the gases away. It is well to compare this state of conditions with present-day practice, and fully to appreciate the great progress that has been made in this direction. We often see, and have demonstrated to us, the progress the machine shops and engineering as a whole have made, and are making, but efforts in the foundry are too often kept in the background, whereas, it is a fact that the progress made there of recent years compares very favourably with efforts elsewhere.

As an illustration of the adaptability in the use of sea-sand cores, the author proposes to describe in detail an interesting job which recently came under his supervision.

Fig. 1 shows a plan of the casting, for which a little over one hundred were called for.

As will be seen from the drawing, unless the core was made up of sea sand, having those easy facilities for fettling, it would, indeed, have been a very difficult matter to get the core out owing to the long legs if, for instance, it were made of loam or even dry sand. It was first suggested that the piece be made in three castings, that is, a return bend (short) and two straight pipes. This was, however, turned down. In discussing the job before making preparations to commence the pattern and core tackle, of which, of course, the core was the important factor, many interesting points cropped up, some being beyond the main consideration of this particular subject. However, it was suggested half a core box be produced in iron, so that the core may be dried in the box before disturbing it. This was turned down as being a cumbersome and expensive part to produce. Finally, it was decided to strikle up each half on a plate in the same manner as a loam core. Two questions then presented themselves: First, that owing to the length of the core and shape, ought a core iron to be used? Whether or not it was really necessary is dubious, but one was used and made ¾-square, cast, so as to enable it to be easily broken when fettling. It was argued that the use of the core iron would greatly reinforce the somewhat fragile core. Secondly, should the core have a vent? The author was much against a vent as being totally unnecessary, but as it could so easily be put in, as will be seen later, one was used. The author is of opinion that sea-sand cores are quite self venting, and sufficiently porous to carry off all the gas formed in any mould.

Making of the Core.

Two plates were cast as A, Fig. 2. These were each 25 ins. wide, 10 ft. long, and ⅞ in. thick. The projections at B formed the vents. The outer edges of the plates were chipped fairly true and smooth to allow the strickle C to run. This strickle was made out of ¼-in. steel plate, with a wide strip welded on at D to give a large wearing surface, as it was found after about one dozen cores had been made this portion was beginning to show considerable wear, and was consequently altering the centres of the cores insomuch as when placed in the mould the metal thickness was deficient on the inner edge and full on the outer. Radius E had to be made ⅛ in. larger than the core size, as it was found the core was too soft, and when baked was not strong enough to hold itself together. To overcome this, after the core had been struck up to a strickle ⅛ in. oversize, it was patted and sleeked down to correct size; this gave it the ramming effect otherwise missing. The core plates were then fixed dead flat on the core carriage, or otherwise the core halves will not come together truly. Two lifting irons made out of 2 in. × ⅜ in. flat wrought iron, marked F, were next placed on the core plates equal distances along its length. The plates were then given a liberal coating of dry sand and the sea sand and core iron placed on, strickled to shape, patted down and placed into the oven for baking.

The core sand was made up of dry Southport sea sand, and the oil used was Glyso diluted by water in the proportion of one part of oil to 25 parts water by volume, and enough of this solution added to make the sand workable. The actual time taken to bake these cores was not recorded, as they were stoved just before closing time and taken out quite ready for use the following morning. The next process was the jointing of the halves together; this, of course, necessitated picking the halves up and turning them over, so that the flat surface could be examined and prepared with gum for jointing. To stiffen the halves therefore, and to prevent them from breaking when on their side, two further wrought-iron straps, marked G, were placed on the cores and over the bottom straps F, and the two bolts H put in. An S hook was then placed through the spaces K, and the core could be easily and safely handled by the crane. The jointing was then made in the usual manner of such cores. To pull the two halves together, flexible wire was bound round the core in four places, and made taut. These wires, by the way, were left on. The core was then placed into the stove to dry the joint. The wires placed round the core, to pull the halves together did not cut into the sand as one would imagine, the sand face being hard enough to resist it.

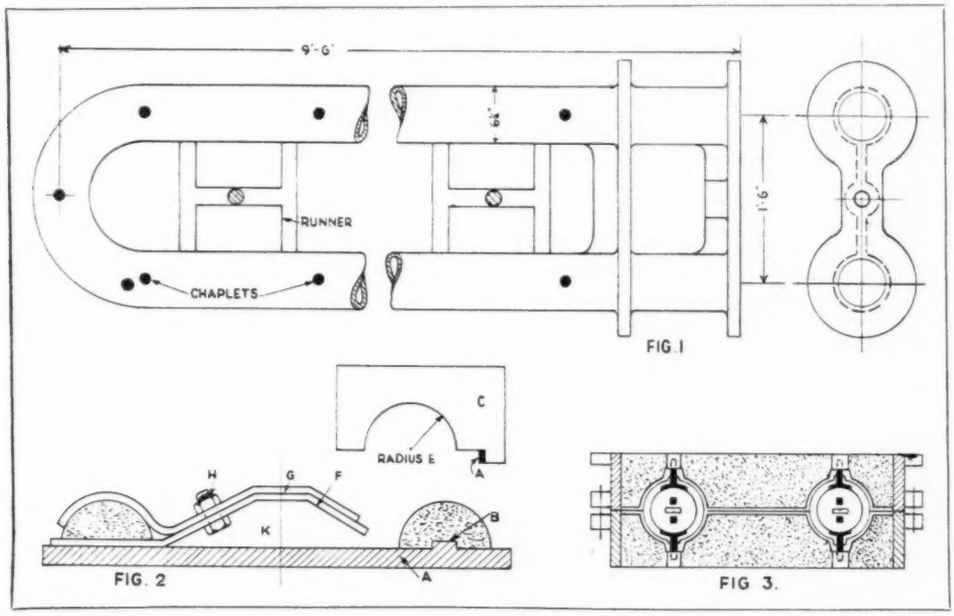


FIG. 1

FIG. 2

FIG 3.

Running the Mould.

The mould was made from a wood pattern in halves, in boxes made for the job, so that in this respect there is nothing specially worth mentioning. It was run at four places, as shown on Fig. 1. The method adopted, however, for carrying, and holding the core in position, is worthy of note. The core was found to be of a very springy nature; this, however, was partly anticipated, in that it was realised when making the box parts a good number of chaplets, both top and bottom would be necessary. As shown on Fig. 1, seven chaplets top and bottom were employed. The fixing and holding down of these fourteen chaplets, unless arranged for properly, would entail a considerable amount of care and time, constituting criteria that count in lowering costs. This particular job cannot be called a repetition job, although a fair number were wanted, and it is because of this point that such jobs are infrequently given that careful attention to detail they warrant. Any job calling for anything more than fifteen castings off one pattern warrants a little more attention to detail than one-off jobs, and such extra attention is sure to pay for itself. Returning to the job in hand, the bottom and top parts of the box were arranged to have seven bosses cast on seven of the box bars, as shown by the section of the box, Fig. 3. These bosses were drilled down about 1 in. with a -in. drill, this being clearance to the stem of the chaplet used. The box parts, of course, were chipped and fitted down properly to fit each other and to give the correct spacing to the joint face and to the bottom of the hole in the bosses. Chaplets were specially ordered to correct length. The bottom chaplets had merely to be dropped into these holes, seeing, of course, the holes were quite clear. The top chaplets were placed in and small wedges (pieces of wire nails cut off and flattened by boy labour) held them into place.

Company Reports.

National Gas Engine Company, Limited.—Dividend, 5 per cent. for year.

Crossley Brothers, Limited.—Net profit, £51,882; brought forward, £73,079; dividend on preference shares, 7 per cent. per annum for first half, £14,118; dividend for second half-year, 7 per cent. per annum on preference; carry forward, £96,724.

Mather & Platt, Limited.—Net profits, £232,946; transfer to tax account, £40,910; brought in, £164,458; final dividend on ordinary shares, 5 per cent., making 10 per cent., free of tax, for year; bonus on ordinary, 5 per cent., free of tax; carry forward, £131,945.

Wigan Coal and Iron Company, Limited.—Debit balance brought forward, £42,529; trading loss for year, £7,815; depreciation written off plant, £57,803; total, £108,147; credit taken from over-provision for taxation, £61,000; debit balance carried forward, £47,147.

Barrow Hematite Steel Company, Limited.—Transferred £90,000 from taxation reserve account; net profit, £119,057; debit balance brought forward, £193,125; now reduced to £74,067; unpaid cumulative dividends on preference shares to December 31 last amount to £114,048.

Birmingham Railway Carriage and Wagon Company, Limited.—Available, £92,513; dividend, 6s. per share, less tax, on 6 per cent. preference for half-year ended December, £2,400; dividend, 2s. per share, less tax, on ordinary; depreciation of plant, etc., £16,000; carried forward, £30,254.

British Wagon Company, Limited.—Profits for 1927 (together with balance brought in), £43,465; interim dividends, 4s. per share on shares £3 paid up, and 1s. 4d. on shares £1 paid up, less tax, and further dividends 5s. and 1s. 8d. per share respectively, less tax; reserve fund, £12,500; carried forward, £15,365.

Institute of British Foundrymen.

NEWCASTLE BRANCH ANNUAL DINNER.

The annual dinner of this Branch was held in the Station Hotel, Newcastle-upon-Tyne, on February 11, Mr. Victor Stobie, Branch-President, presiding, and about 100 members and ladies being present. Amongst the guests were the Deputy Lord Mayor of Newcastle, Dr. R. W. Simpson, Mr. J. T. Goodwin, M.B.E., M.I.M.E., President of the Institute, Mr. T. Makemson, General Secretary, Mr. Dunford Smith, Chairman of the North-East Coast Section of the Institute of Metals, and Mr. W. Dymond, of the Marley Hill Chemical Company.

After the toast of "The King" had been honoured, Mr. C. Gresty proposed that of "The Prosperity of Tyneside." He said that he was optimistic enough to believe that trade on Tyneside was steadily improving, even if rather slowly. They had passed through several very lean years, but he thought one good sign was that everybody realised more than ever before that industrial upheavals such as they had had benefited nobody, and only resulted in colossal damage to the trade of the country. To bring back the prosperity which they all desired, the greatest necessity was hard work on the part of everyone.

Responding to the toast, Dr. Simpson said most of their difficulties were past now, and they could all help by being optimistic. He thought the period of depression might have helped them to some extent. They were beginning to realise that to compete with trade rivals all over the world they would have to work hard. The classes of a technical and commercial nature which were being held in Newcastle were very succesful. The School of Commerce which had just commenced two or three years ago now had three to four hundred pupils. The Principal of Rutherford Technical College had said that he was struck with the enthusiasm of the pupils and their desire for accurate knowledge. For that reason he (Dr. Simpson) thought that the foundations of the future prosperity of Tyneside were being properly built. Newcastle was one of the lowest rated towns of its size in the country; they could not make any startling reductions in the rates, as they had never raised them. Although Newcastle had carried out many big schemes the expense had been justified. War, either of politics or of trade, was sheer idiocy. If arbitration failed, then war could not possibly succeed.

The toast of "The Institute of British Foundrymen" was proposed by Alderman E. Smith, J.P. In his opinion, the Institute was doing its best to raise the standard of the foundrymen so that the foundry would be acknowledged in its rightful place as the very keystone and foundation of the engineering industry. The members of the Institute tried to solve foundry difficulties as they arose, and they gave knowledge gained by experience to their fellow-members.

Mr. J. T. Goodwin, replying, said future generations would have to be more scientific and have a thorough technical education to face their problems. Technical School Committees to-day ought to have representatives of the foundry trade in order that a schedule of classes which would meet the requirements of the trade could be placed on their syllabus. It was his hope that one day there would be an entrance examination for the Institute, one which would have a national recognition and be accepted by employers as a standard of ability. They now wished, however, that Associates who had moved into better positions would become members wherever possible in order to keep up the status of the Institute. It was only right and just that they should do so.

The toast of "The Ladies" was proposed by Mr. W. J. Paulin in a humorous speech, Mrs. Victor Stobie, F.R.S.A., responding.

Mr. Makemson, General Secretary, said that with regard to the question of membership of the Institute, he thought they had come to the stage in the Institute's history when a definite and considerable increase in its membership was desirable and, in fact, necessary. Quite apart from the financial point of view, which was, of course, important, it was one of the peculiarities of an association like theirs that the larger the membership the more successful was its work. Many of the papers which were read embodied the experience of a lifetime; such a pooling of experience was more effective when there was a greater number of people interested in the same industry in its membership. Owing to bad trade members had been leaving in fairly large numbers, and it was not until about nine months ago that new members had begun to outstrip those who were leaving, a net increase of about 100 members being found when the roll had been made up in June, that being a satisfactory state of affairs. The Newcastle Branch had a record number of subscribing firms and a record number of Associates. In one firm alone in Newcastle there was over forty members of the Institute, which spoke eloquently of the enthusiasm of somebody in that firm, and also of the attitude of the firm itself. He hoped that they would organise a propaganda campaign in Newcastle shortly. In proposing the health of the Chairman, Mr. Victor Stobie, Mr. Makemson mentioned that in addition to being a metallurgist of considerable note, Mr. Stobie was also an electrical engineer. He had been one of the pioneers of the electric furnace not only in England, but in the whole world, and they ought to be proud of him in Newcastle.

Mr. Stobie, replying, said that the decline in the membership of the Newcastle Branch was, he thought, more apparent than real. He had visited one or two of the other Branches, and learned that they had sub-sections at different places. For purpose of comparison, therefore, the Middlesbrough Branch ought to be attached to Newcastle.

An enjoyable musical entertainment was given by Madame G. Hibbs, Mr. William Hendry and Mr. D. C. Hibbs, the accompanist being Mr. T. Pearson, L.R.A.M.

Lancashire Junior Foundrymen's Social Evening.

The annual social function of the Junior Section of the Lancashire Branch of the Institute of British Foundrymen was held on February 25 at Winn's Café, Corporation Street, Manchester, and took the form of a tea, followed by a concert and informal dancing. Ladies had been invited for the first time in connection with these socials of the Junior Section, and the company numbered about 70. Mr. T. Makemson, the chairman, presided. The general arrangements were in the hands of the joint secretaries, Mr. R. Yeoman and Mr. A. Burgess. Amongst those present were the honorary secretary of the Lancashire Branch, Mr. H. Stead, and Messrs. R. A. Miles, S. Smith and Mr. A. L. Key, all Branch past-Presidents. Entertainment was provided by Mr. E. Pattison (pianist), Mr. G. Ward (violinist), Mr. B. Lamb (tenor), and Mr. S. Gray (humorist).

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Skin on Brass Castings.

Sir,—As one who is in charge of a small brass foundry, and not being satisfied with the appearance of castings made, I should much appreciate any practical information you could supply that would assist me in bringing my castings up to the appearance of those I have seen.

My chief difficulty is that, after the castings have been dressed, the skin remains rough, *i.e.*, it has both a coarse and dirty appearance.

Best scrap metals are used, and moulds are made from a mixture of new and old Worcester red sand. Although special attention has been paid on many occasions, I am unable to improve the skin of the castings made.

The reason for my writing you is that I have recently seen some brass castings, made chiefly for show work, which have a splendid appearance, being both very smooth and clean, but are not sand-blasted; in fact, I am told they are cast like it.—Yours, etc.,

B. J. C.

February 25, 1928.

Random Shots.

Plenty of us can remember—and that with no very great effort—exhibitions of the "wonders of science," at which we gazed in admiring awe on gyroscopic toys and X-ray demonstrations and the like. To-day it is a little "demodé" to confess that you have an imagination so easily stirred. Consequently it was quite a shock to find how much popular interest was aroused by the recent joint meeting of the Institution of Electrical Engineers and the American Institution of Electrical Engineers held by the medium of wireless. Difficulties of time and space alike were overcome. How romantic that sounds! And, indeed, if we were not quite so *blasé* about these things we should conceive the whole business in quite as romantic a light as any of Jules Verne's inventions. Who knows, we may even live to read in our morning paper that some intrepid explorer has taken a header into space in a glorified projectile, and, commenting on it between two mouthfuls of bacon and egg, remark that we hope it isn't a hoax this time!

* * *

Bacon and eggs! Yes, I confess quite shamelessly to one personal prejudice where scientific development is concerned. May heaven prevent any reduction of the grosser and more material joys of life to tabloid form! The idea of consuming a six-course dinner complete with beverages by the simple expedient of masticating a mud-coloured capsule does not leave me merely cold—it positively chills me! Simplify amusements, communications, correspondence, what you will, but leave our palates alone!

* * *

And, talking of six-course dinners, a correspondent, inspired by my tale of the Englishman in Paris, sends me the following, for whose authenticity he is prepared to vouch. Another Englishman, this time a hardened traveller, dining in Paris, asked his waiter the best way to a certain Montmartre attraction. The waiter told him. "Monsieur knows Paris?" "Yes, very well." "Because monsieur will know that there are thieves in Montmartre." "Indeed!" "But yes, monsieur, of two kinds. The ladies, who take your money *with* your knowledge, and the waiters, who take it without." "The waiters! How so?" "But yes, monsieur, they add up the bill wrong!"

* * *

And talking of the French, they have an excellent phrase about "Autres temps, autres mœurs," which, being interpreted—somewhat freely—is to the effect that every age has its own prejudices. In illustration whereof, recall the scandal created by one George Bernard Shaw when he made free use in his play "Pygmalion" of a certain expressive but inelegant expletive. And then, by way of contrast, consider the fact that no less highly respected a person than Dean Inge clinched an argument in a recently-published article with the tale of the working man at a lecture who refused the offer of paper and pencil for note-taking purposes with the remark, "Wot's my bloody 'ed for?"

* * *

And while on the topic of language, there is a story about a dear old lady who owned a parrot brought home from abroad by the usual sailor nephew. And the said parrot's fluency was such that he was in the habit of retiring, cage and all, behind a dark cloth on Sundays, lest the Sabbath should be desecrated. One unfortunate Monday morning, however, the vicar of the parish elected to come calling. The parrot was heard to remark, as the cloth descended in haste, "It's been a damn short week!"

Marksman.

Mr. P. Krishna Rao, the foundry superintendent of the Mysore Iron Works, Bhadravati, India, is at present in England and is staying at the Hotel Russell, Russell Square, London, W.C.2.

Age-Hardening of Alloys.

A Review and Some New Observations.

A Paper on "Age-hardening of Alloys" was read by Dr. Hay, of the Royal Technical College, Glasgow, at a recent meeting of the Glasgow Branch of the Institute of Metals.

Dr. Hay said that the phenomenon of age-hardening was first observed in a marked form in an alloy of aluminium with 3.5 per cent. of copper and 0.5 of manganese called duralumin and discovered about 1902 by Wilm in Germany. No great interest was taken in the alloy and its peculiar ageing property until during the war, when light alloys were greatly in demand. A further impetus to this study was given by the Washington Conference in 1921, when the limitation of the tonnage weight of naval ships led to an extended use of light alloys.

The term "age-hardening" literally meant hardening with age or time. In that statement no reference was made to temperature, it being understood that room temperature was referred to. Within recent years, however, the function of temperature had also had to be considered, as with an extended knowledge of alloys others had been discovered which, although they did not age-harden at room temperature, did so at higher temperatures. It had also been noted that the hardness of alloys susceptible to this phenomenon varied with temperature. The general mechanism of age-hardening was now clearly understood. Fundamentally, it depended upon the size of the particles present in the alloy. Generally, the alloy consisted of a predominating amount of one element with some other substance distributed through it. It was the size of the particles of the distributed material which was of vital importance. When the particles were massive—that is, pieces which were just visible under the microscope—they caused no serious distortion as a general rule. But when they occurred as very minute, finely dispersed bodies they did cause serious distortion with corresponding increase in hardness. Moreover, the smaller the particles became, the larger the surface area became. This was shown as follows:—

Size of cube.	No. of cubes.	Total surface area.
1 cm.	1	6 sq. cms.
1 mm.	10^3	60 ,, ,,
0.1 mm.	10^6	600 ,, ,,
0.01 mm.	10^9	6,000 ,, ,,
0.001 mm.	10^{12}	60,000 ,, ,, or 6 sq. mtrs.
0.0001 mm.	10^{15}	60 sq. metres.

Thus a small quantity of material might take up considerable room and present a very large surface area.

When a substance separated from solution it formed very small nuclei, and these grew into larger crystals. The rate of formation of these nuclei and the rate of crystal growth were the two important factors in crystal formation. When passing from the liquid solution state to the solid state it was difficult to control these variables, although in certain cases this was possible. But when they had a solid solution from which the substance separated it was more easy to control this rate of crystal formation. In order to get this separation it was necessary that the substance which was in solution should be more soluble at a high temperature than at a low temperature. Now it so happened that in the case of duralumin the Mg_2Si was soluble 2 per cent. at 500 deg. C., and only 0.5 per cent. at room temperature, and that $CuAl_2$ was soluble to the extent of 5.6 per cent. at 548 deg. C., and less than 0.5 per cent. at room temperature. Hence if duralumin be heated to about 520 deg. C. and then quenched in water these compounds would be retained in solution—solid solution. But slowly at room temperature these constituents were precipitated from solution as very fine particles—so small that they could not be seen under the microscope—and, of course, a distortion of the aluminium crystals resulted, causing an increase in the hardness of the alloy, just as cold work by hammering increased its hardness. This was shown by the following table:—

Time in hours after quenching.	Brinell No.	Maximum stress. Tons per sq. in.
0	65	16.5
5	88	18.5
10	96	21.5
15	101	23.5
20	105	24.5
25	108	25.0
30	110	26.0
35	110	26.0

If, however, the specimen be slightly strained after quenching and then allowed to age, there was a peculiar drop before hardening began which was not noticeable in the ordinary treatment. This was shown as follows:—

Time (hours).	B.H.	B.H. (stressed).
0	70	70 (before stressing). 70 (just after stressing).
½	70	61
1½	72	70
3	74	78
4	80	84
6	80	84
23	86	86

This depression, after quenching and before hardening commenced, had been noticed by Guillet in the aluminium-copper alloys in which the aluminium was richer, after an hour or so. Increase of temperature caused a coalescence of these finely dispersed particles, and as they coalesced the cause of the distortion was removed, and with increasing temperature this strain on the metal was removed and the metal changed to its normal state. Thus in duralumin, by increasing the temperature, the specimen gradually softened:—

Reheating temperature, deg. C.	Maximum stress. Tons. per sq. in.
— (Aged condition)	30.4
100	30.2
200	27.8
300	19.2
400	17.8
450	19.6
475	20.8
500	22.2

Thus after 400 deg. C., the precipitated compounds went into solution again and caused an increase in hardness. Temperature also influenced the precipitation of the compound from solution. Taking duralumin as an example once again, it would be found that whereas the alloy age-hardened and attained its maximum hardness after a period of four days or so, if the temperature be increased to 100 deg. C., the ageing could be effected in as many hours, and at 150 deg. C. in as many minutes; but if 250 deg. C. be exceeded the alloy would soften. Furthermore, the temperature of precipitation caused a difference in the amount of hardening, there being only one temperature which would give the correct conditions for precipitating the material in the correct size. If below this temperature sufficient would not be precipitated; in fact, if too low, such as at the temperature of liquid air, there would be no hardening as there would be no precipitation even after a long period. If the temperature was above this correct temperature on the other hand, the precipitate would be too coarse to produce maximum distortion. With duralumin the best results were got at about 200 deg. C., provided the time factor was correct. When this separation of the dissolved substance took place it did so with a change in volume. A temperature-expansion curve showed that precipitation commenced rapidly about 180 deg. C., and continued up to 280 deg. C. On cooling, the curve showed a gradual change indicating a continual diminution in volume until 260 deg. C., below which temperature it was regular. This would indicate that a continuous change had taken place from 410 deg. C. to 260 deg. C., due to continuous deposition of the small amount of compound which had gone into solution above 350 deg. C.

The time of soaking at the high temperature before quenching was of equal importance. If the particles of compound in the original cast material were coarse—of large size—then an appreciable time was required for their solution. It was lack of knowledge on this point that caused the opinion to be widely held that duralumin castings could not be satisfactorily age-hardened. But soaking too long was probably worse than not soaking long enough. It would result in a coarse structure, and also the compound when precipitated would tend to be at the grain boundaries, giving a weak structure. The following figures* showed this effect of increasing time upon the Brinell number:—

	Not quenched.	B.H. immediately after quench.	B.H. 96 hrs. after quenching.
As cast (chill) ..		0.475deg.C	
As cast (chill) ..	60	—	—
½ hr. at 475 deg.C. and quench	—	59	80
1 hr. do.	58	84.58	84
2 hrs. do.	—	59	90
4 hrs. do.	—	62	87.5
10 hrs. do.	—	68.5	94.5
As cast (sand) ..	53		
½ hr. at 475 deg.C. and quench	—	49	62
1 hr. do.	—	57	73.5
2 hrs. do.	—	53	74
4 hrs. do.	—	60	80
10 hrs. do.	—	61	84.5

The size of the article would also influence the degree of hardness age-hardening attainable. In the case of larger castings, not only was there the trouble of the compound being in a coarser state due to the slower rate of cooling—and so requiring longer time to go into solution—but also the quenching after soaking would be less effective, and so less of the compound would be retained in solution. The effect of size was shown in the following table:—

Sand cast.	Heated to 525 deg.C. for 10 hrs. and then aged for 10 hrs. B.H.
10 mm. thick.	98
22.2 mm. ,,	80
42 mm. ,,	65

Very many systems showed this phenomenon of age-hardening. In the case of Al—Ag the solubility of the aluminium was 1.3 per cent. at 20 deg. C. and about 9 per cent. at 525 deg. C. The maximum hardness was got by quenching and ageing at 130 deg. C., but it was not quite as good as duralumin. Germanium might replace the Si in duralumin type of alloy, but its age-hardening powers was not so great. The ageing must be effected about 150 deg. C. A compound Mg_2Ge was formed which was more soluble at a high temperature than at room temperature. With Cu—Cr 0.05 per cent. of chromium was in solution in the copper at 500 deg. C., and 0.8 per cent. at 1,000 deg. C. Here 0.6 per cent. of chromium sufficed to produce maximum hardness. The ageing temperature was 500 to 600 deg. C. With Cu—Co 0.35 per cent. of Co was in solution at room temperature and 3.4 per cent. at 1,000 deg. C., and the B.H. maximum number was 105. In the case of Cu—Si about 2 per cent. of Si was in solution at room temperature and about 6.8 per cent. at 800 deg. C. With 6.7 per cent. Si a hardness of 280 B.H. was obtained on ageing as against 110 in the quenched state. In the case of FeMo the iron retained 24 per cent. of Mo at 1,440 deg. C. and about 6 per cent. at room temperature. With Fe—W the iron retained at 8 per cent. W. at room temperature and up to 33 per cent. at 1,525 deg. C. No FeW_2 precipitated until the tempera-

* "The Metallurgist," April, 1925, and December, 1924.

ture was about 600 to 700 deg. C. The hardening gave under the best conditions 450 B.H.

The application of age-hardening of alloys to obtain the best mechanical properties was now quite general practice, and quite a number of alloys were on the market to meet the different requirements. Obviously the same alloy would not do for all purposes. Where the temperature at which the alloy was to be used was about 250 deg. C. (or even lower) duralumin would not be suitable, as it would soften, with a loss of strength. The volume change due to the precipitation of the compound from solution caused by age-hardening should also be borne in mind. Thus in a complicated casting which had to be aged it was necessary to design the pattern in accordance with the characteristics of the alloy, the chief point being the use of fillets rather than sharp angles between heavy and light sections.

Another point of interest lay in the white metalling of an age-hardened duralumin connecting rod. Ordinary white metal for a bearing melted in cast at about 350 deg. C., at which temperature the duralumin would be softened. Here it was impossible to cast in the bearing and then age, as (1) the bearing would melt during heating for ageing, and (2) during volume change it might break away. Therefore, it was necessary either to use a modified type of alloy which would allow of casting in the white metal big end without damage, or to cast the white metal separately as a die casting and then expand it into the connecting rod.

Meissner had definitely concluded from his work on the corrosion of aluminium alloys in sea water that there seemed to be a critical state of dispersion for corrosive properties; that was to say, there was a maximum loss of weight for this degree of dispersion. In the quenched state the loss was very low, but as the temperature of ageing was raised the rate of loss of weight increased to a maximum of about 150 deg. C., and then it fell again.

It was important to bear in mind not only the composition of the particular alloy, but even more so its state and history. Temperature control was very important.

The Inspection Bugbear.

By "Onlooker."

In most walks of life "seeing is believing," but the dealer or manufacturer who believes what he sees, or perhaps it would be fairer to say *all* he sees, when inspecting a parcel of scrap is heading for trouble. Generally speaking, foundry trade buyers leave the difficult task of assessing the contents and value of a consignment of old metal to those to whom long experience has given something of a "sixth sense" in these matters, and safeguard themselves by buying on sample. The decision is a wise one, for summing up the *melting* value of scrap is no easy job.

When scrap can be viewed in its own "home," *i.e.*, at the works or rolling mill where it is being made, an accurate idea can be formed of its probable bulk nature, for the material is plainly visible in process of accumulation, and, barring accidents—such as the sweeping up with the scrap of extraneous matter—a parcel of really first-class reliable material should be available. This is inspection under conditions as nearly ideal as possible, but, unfortunately, the job is not usually so simple and straightforward as that. If it were so scrap dealers would have fewer complaints from customers to investigate, and, incidentally, the whole status of the old-metal market would be raised considerably, for the suspicion with which buyers at present regard anything except virgin metal would disappear.

Broadly speaking, the problem of accurate estimation of the value of a parcel of old metal falls under two headings—the stuff and the place. More often than not "the order to view" will direct its holder to one of the metal sheds at a large railway terminus, where, if trade be slack and demand at low ebb, enough material will be found to stock half the foundries in the Midlands. These railhead depôts are a very good guide to the state of trade, and the balance existing between supply and demand, for when business is brisk the tonnage is kept down and material moves on quickly, but with buyers "marking time," scrap—and virgin metal, too, for that matter—accumulates with wonderful rapidity.

An inspection order on a railway company will ensure its holder every attention from the officials, who are always ready to arrange for a couple of men to shift a few bundles or open some bags if required. Their courteous co-operation helps to smooth the way, but however willing they may be, "light cannot be shed in dark places," and some of our metal sheds at railway termini are very dark indeed! Another difficulty arises from the fact that the total parcel offered for sale is often made up of two or three lots under different "pro numbers," and it is necessary to cover a good deal of ground before inspection can be completed. Such a jaunt is not very pleasant on a wet day, and if the dumps are in the open, and sheeted against the weather, a correct estimation is doubly difficult.

Perhaps the most trying job of all is to overhaul material lying in a truck or stacked on a van waiting to go out to a customer, for little more than the top layer can be seen, and this view is only obtained by the exercise of agility, amounting in some cases to an acrobatic feat. Obviously all opinions formed from material viewed under the conditions described above must be very guarded, but such inspection, coupled with a knowledge of the seller's trade reputation for straight dealing, and the *general* reliability of the class of scrap under consideration, will go a long way towards the making of a decision.

Having dealt with one or two aspects of the "place" difficulty, let us turn to the question of the material itself. With heavy stuff, such as gunmetal bearings, machinery brasses, etc., a summing up of a consignment is fairly straightforward, for the units of the parcel are large, and their form and shape characteristic, but in dealing with light material greater care must be exercised. Brass-sheet cuttings, either in pressed bundles or loose in bags, are usually in good demand, and their quality should be approximately "two and one," but there is always a risk of hot-stamping sections or cast metal being included, and it is wise to have a few of the containers tipped out and the contents carefully examined. Free iron (not easily detected when the brass is discoloured) is another bugbear, and if any suspicion attaches to a parcel, the magnetting machine is the only means of correction. Light collected brass may turn out to be soldery, and if only two or three "bad eggs" are found in a bag it is just as well to expect the worse and look for trouble in the others.

Long-length tubes, whether in brass or copper, require very careful consideration, for in the first place brass which has "weathered" and lost zinc from the outer surface may easily be mistaken for copper at a cursory glance. The interior of a tube is no guide, for it is almost invariably foul, and the only quick test is to scrape the tube deep enough to reveal the true nature of the metal. It is no uncommon thing to find the ends of tubes not intended for re-drawing flattened, and it is no unusual event either to discover, on sawing through the pipe or splitting it lengthwise, that a very liberal allowance of scale and dirt is present. Iron collars are sometimes found at the ends of tubes, *inside*, but they must usually be *felt* for. Tubes offered for re-drawing should be very carefully overhauled, and a percentage of any parcel split lengthwise to facilitate a careful examination for interior defects. Such material commands a premium of from £6 to £8, and must be judged accordingly.

There are traps for the unwary in copper scrap as well as in brass, and the dealer who is called to inspect a consignment of wire will do well to remember that iron when rusty is almost indistinguishable from copper. Balled-up copper wire with iron mixed in it is often met with, and the foreign matter will never be spotted on a cursory examination. Best by far to break up some of the bundles and test by the feel of the material what is iron and what is copper. Old cable made up into pressed bales for the furnace often brings lead with it, for if the insulation is melted off, some, at any rate, runs into the stranded cable and stays there until the copper goes into the furnace. Bronze wire is very easily passed as copper, and here again the harder nature of the alloy is the only real guide.

It has been impossible in a short article to do more than touch on the fringe of the subject of inspection of old materials in the world of non-ferrous metals, but enough has been said perhaps to indicate the difficulties of the work. A golden rule is to take nothing at its face value, and to remember that all scrap is *discarded* material, and has, therefore, ceased to be of use until re-melted. Last but not least, scrap usually changes hands several times in its journey to the foundry, and it does not improve on its travels!

American Duty on Pig-Iron.

According to the "Iron Age," difficult problems surrounding administration of the Tariff Act are pointed out by the Tariff Commission in its eleventh annual report to Congress. A number of them concern means of ascertaining costs of production according to requirements of the flexible provision, by which duties may be increased or decreased 50 per cent., which, in instances, the commission has found to be inadequate. A case in point relates to pig-iron. The increase of 50 per cent. in the duty on pig-iron, proclaimed by the President, effective March 25, 1927, permitted a maximum duty of only $1.12½, raised from 75c. per ton. "Such increased duty fails by a wide margin to equalise differences in costs of production indicated in the commission's report," it is pointed out.

It is also explained that by section 315 (flexible provision) nothing shall be construed to authorise the transfer of an article from the dutiable list to the free list or from the free list to the dutiable list, although applications have been filed with the commission requesting investigations looking toward complete removal of the duties on certain articles, or the imposition of duties on articles now on the free list. It is stated that although action by the President is limited in such cases, information obtained by the commission is available for the use of Congress.

The report directs attention to an opinion of the Attorney-General that in finding the differences of costs in producing foreign and domestic articles there should be taken into account, among other things, costs of transportation, where it is shown such differences in costs, as between foreign and domestic articles, constitute an advantage or disadvantage between the foreign and American producers. Prior to this opinion the commission had presented cost comparisons both with and without transportation costs. Since the Attorney-General's opinion, February 2, 1926, all cost comparisons have included transportation costs.

The most important question, it is stated, concerns principal markets of the United States where imported and domestic goods meet in competition. If the principal market is a port of entry, the transportation charge for imported goods is composed of the foreign inland freight and ocean transportation. The domestic plants may be scattered over a wide area.

"Upon what basis should domestic transportation to the principal market, wherever located, be calculated?" asks the commission. "Upon the basis of the nearest group of plants, the most distant group of plants, or on the basis of an average transportation charge from all plants?

"Under existing circumstances, it may be found that a principal market for the domestic products is at one point and the principal market for imported goods is at another point. In fact, the domestic and imported goods may not actually meet in the same market. Under these conditions should transportation for both domestic and imported articles be calculated to their respective markets only? In such an event how shall the commission determine the principal market?"

The report shows also that the ascertainment of invoice prices as evidence of production costs is not free from difficulties.

The Selection of Pig-Irons and Similar Raw Materials Used in the Manufacture of Grey-Iron Castings.

By Arthur Smith, M.A.

Pig-iron is probably the most important raw material used in the manufacture of all classes of grey-iron castings, yet the selection and purchase of this material is often carried out in the most haphazard and uneconomical manner. In England and Wales pig-irons are produced in some fifteen areas or regions, various types of ores being reduced to pig-iron in a multiplicity of different grades of purity or impurity, the value of the final blast-furnace product usually depending on the exact quantity and balance of the useful impurities contained therein. Much pig-iron is, of course, also made in Scotland.

Ores Available.

In nature, iron is one of the most widely distributed metallic elements, and in Britain its chief ores (apart from sulphide ores) take the form of oxides and carbonates of the metal, the more important being (1) red hematite and specular iron ore (Fe_2O_3); (2) brown hematite ($2Fe_2O_3$, $3H_2O$); (3) magnetic iron ore (Fe_3O_4); (4) spathic iron ore and clay ironstone chiefly ($FeCO_3$); and (5) blackband ore, which consists of clay ironstone, intermingled with some 20 to 25 per cent. of coal. Usually the ores are first calcined to drive out water and carbon dioxide, and to oxidise any small quantities of sulphide present. The calcined ore is now not only in the fully oxidised condition but has also been rendered more porous, and in a suitable condition for rapid reduction to the impure metal by means of coke and limestone, the smelting operation being usually carried out in a modern blast furnace using hot blast.

The resulting pig-iron invariably contains varying proportions of carbon (either as graphite and carbide of iron or more frequently as both), silicon, phosphorus, sulphur and manganese, the exact composition depending on (1) the purity and otherwise of the ore used, (2) the amount of loss or gain of these impurities whether accidental or intentional during the smelting process, (3) the control of the smelting operations with a view to attaining a definite composition in the blast-furnace product.

Distribution of the Elements.

The amount of carbon present in blast-furnace pig-irons usually varies between 3 and 4.5 per cent., the latter amount being found in certain types of hematites. The amount present depends on the amounts of other elements present, as well as on the smelting conditions.

Silicon exists in pig-irons in quantities varying from about 0.3 up to 5 per cent. In some cases special high silicon pig-irons are produced containing 7 to 10 per cent. silicon, but these might almost be regarded as ferro-silicon alloys. The iron ores and other materials in the furnace charge always contain silicon dioxide or silica SiO_2, which is reduced during the smelting operation, and thus finds its way into pig-iron as silicide of iron. The proportion which finds its way into the pig-iron depends on the working conditions of the furnaces, more especially on the working temperature of the blast furnace and the ratio of limestone in the charge.

The amount of sulphur present in pig-iron varies from less than 0.01 per cent. up to 0.25 per cent. Like silicon the percentage of sulphur present varies greatly with the working conditions of the blast furnace as well as with the composition of the charge materials including the fuel.

The amounts of phosphorus and manganese are usually moderately constant in pig-irons smelted from the same raw materials with the result that, generally speaking, irons do not vary much in one particular district. Phosphorus may be present in quantities ranging from traces up to about 1.8 per cent. All the phosphorus present in the ore is reduced in the blast furnace, and is found in the pig-iron. High phosphorus is associated with pig-iron produced from clayband and blackband ironstones, and the percentage found in this class of pig-iron is usually from 1.2 to 1.6 per cent. Manganese usually varies from 0.3 to 2.0 per cent.

Range of Choice.

A glance at the blast-furnace statistics for the quarter ending December, 1927, will show that in Great Britain some 147 (out of a total of 427) blast furnaces were in blast, 38 on hematite, 72 on foundry pig-irons, 31 on basic pig (mostly for steel manufacture) and 6 on ferro-manganese. When one considers that these are situated over a wide range of localities, consisting approximately of 16 groups (all Scotch furnaces being grouped together), representing 65 different plants out of a possible 109, and of which 49 are working on hematite and foundry irons, one can readily realise the great variety of pig-irons available, but the problem for the grey-iron foundry industry is how to select from this material so as to attain the best possible economic advantage and margin for any individual type of production, no matter how low-grade or high-grade, no matter how low-duty or high-duty.

Under present-day conditions some or all of the following variable factors will severally and collectively determine the selection of any brand of pig-iron for any particular class or type of casting or castings:—(1) Limits of composition of pig-iron; (2) suitability of such composition whether the pig-iron is to be used as basis or only as corrective portion of proposed iron mixture; and (3) total cost per ton delivered to the foundry melting plant.

How to Specify Requirements.

All pig-iron should be ordered to a definite specification of composition, and the limits of that specification should be just so wide or just so close as are absolutely necessary. Far too many specifications for pig-irons are drawn up with ridiculous limits, some too wide, but many much too narrow for practical purposes. Specifications should be drawn up with the utmost skill and reason, but, alas, this is not always the case. Unfortunately there are some works chemists, metallurgists and foundry managers who do not deal with this matter from a sufficiently common sense point of view, failing to realise that unnecessarily close limits may mean a higher price. It is much better to give the manufacturers of pig-iron fair limits for the grade of iron specified, and then hold them definitely to the limits agreed on. A very convenient and profitable practice is for the responsible person to compile a specification for the particular range of pig-iron which is required, and to have that specification circulated to a number of suppliers who are likely to have parcels of iron near the quality required. Some suppliers will almost certainly state that they cannot quite supply to the limits required but will offer something near, with definite limits and at a certain price. Then the metallurgist can arrange, if necessary, to modify his specification slightly to get the material which will just be good enough for his requirements and yet be obtained at the most favourable price.

A Practical Classification.

Perhaps it may be helpful to give a few specimen specifications by way of example. Consequently it will be convenient for the purposes of this article to classify available pig-irons into a number of broad or arbitrary groups quite irrespective of districts in which they are produced and the like. The following will be found to be a very convenient system of classification for explanatory as well as for selection purposes. In ten groups it covers all the available materials.

Group I. Hematites.—All types for cast-iron trade. Total carbon usually high, and may go as high as 4.5 per cent. Silicon and manganese can be had in nearly all ranges as required.

Group II. Phosphoric Irons.—Phosphorus 1.1 per cent. and over. Silicon can be had in most ranges, the sulphur and total carbon are usually normal, whilst the manganese in most cases is low.

Group III. Medium Phosphorus Irons.—Phosphorus 0.5 to 1.0 per cent. (Scotch type). The silicon can be as required; the manganese is usually medium to high, and the total carbon and sulphur are usually normal.

Group IV. Low Phosphorus Irons.—Here the phosphorus is under 0.5 per cent., the silicon as required, and the manganese medium to high. The total carbon and sulphur are normal.

Group V. Moderately low total carbon irons with high phosphorus.

Group VI. Moderately low total carbon irons with medium phosphorus.

Group VII.—Moderately low total carbon irons with low phosphorus.

The three Groups (V, VI, and VII) comprise the so-called cylinder irons, and might be taken as sub-groups under Groups II, III, and IV respectively. Here the total carbon is 3.2 to 3.5 per cent., the silicon under 2.0 per cent. in ranges as required, and the manganese usually fairly high.

Group VIII. Definitely low total carbon, low phosphorus irons. These irons are rarely finished in the blast furnace, and collectively form the so-called refined irons.

Group IX. Genuine charcoal irons.

Group X. Genuine cold-blast irons.

Sample Specifications.

A few sample specifications for pig-irons for different purposes are given to show how the range of the limits to be called for should be adjusted to meet the requirements.

No. 1.—Suggested specifications for a general purposes phosphoric iron (Group II), suitable for mixing with hematite irons, and also for carrying a large percentage of moderately low-silicon scrap iron in the mixture:—TC, 3.3 to 3.6; Si, 3 to 3.5; Mn, not less than 0.6; S, not over 0.05; and P, 1.6 per cent. absolute maximum.

If so high phosphorus is detrimental, then irons of Groups III and IV become available, the other constituents remaining constant. The price, of course, will go up with lower phosphorus specified.

No. 2.—Suggested specifications for a hematite iron (Group I) for mixing with high-phosphorus irons (Group II), and to carry a high percentage of heavy scrap iron in the mixture:—TC, 3.5 to 4.0 absolute maximum; Si, 2.8 to 3.3; Mn, 0.8 to 1.2 or 1.0 to 1.5; S, not over 0.05; and P, not over 0.15 per cent. The phosphorus figure is purposely given as not over 0.15 per cent. as the iron is to be used neither for steel making nor for the manufacture of low-phosphorus cast-iron.

No. 3.—Suggested specification for high-silicon pig-irons to be used along with light cast-iron scrap in manufacture of light, soft cast iron (Groups II and III being available):—TC, 2.9 to 3.3; Si, 4.0 to 5.0; Mn, not less than 0.35; S, not over 0.03; and P, not to exceed 0.8 per cent. This specification can be modified to read, "Phosphorus not to exceed 1.8 per cent," if high-silicon hematite is to be used in the mixture. When only the cheapest high-silicon irons can be used, on account of low selling price of some light castings, then only Group II pig-irons are available, but even in the lightest castings it is inadvisable to have phosphorus in the final product much over 1.0 per cent., on account of the resulting excessive brittleness when that figure is greatly exceeded.

No. 4.—Suggested specification for pig-iron for machinery castings where it is not intended to use hematite in the mixture:—TC, 3.3 to 3.8; and Si, 2.5 to 3.0 per cent.—this can be adjusted to suit the requirements of the work, the amount and class of scrap iron, if any, being used in the mixture—Mn, 1.5 to 0.8 absolute minimum; S, not over 0.05; and P, 0.5 to 0.7 per cent.

No. 5.—Suggested specification for so-called cylinder irons (Groups V, VI, and VII), where scrap iron is used in the mixture in addition to "remelt":—TC, not to exceed 3.3; Si, 1.2 to 1.4—these figures can be lower or higher as required

for the work on hand, but the limit range should never be more than 0.2 or 0.3 per cent.—S not over 0.06 and P not over 0.6 per cent. This figure may have to be lower for certain classes of work whereas in some cases it may be legitimate to go up to 0.8 or even 1.0 per cent. It should be remembered that as a general rule low phosphorus irons, especially under 0.5 per cent., are more expensive than high phosphorus irons.

The above series of examples could be elaborated and extended almost without limit as all sorts of combinations between silicon and manganese may be called for and can be obtained in most of the groups, and where several pig-irons are used in any mixture of any series of mixtures, the proportions of differently specified irons can be varied to give the same predetermined final composition with the greatest economy.

Apart from charcoal and genuine cold-blast irons, it is only necessary to call for iron to analysis, the question of brand being immaterial, always provided the pig-iron supplied does conform to the limits laid down in the specification to which the pig-iron has been purchased. With modern hot blast pig-irons, it is futile to purchase by fracture.

Fracture and Analysis.

Fig. 1 shows sixteen fractures of pig-irons, the analyses of which are given in Table I. It will readily be seen that selection by fracture is impossible in modern foundry practice.

Table I.—*Analyses of Pig-Irons, the Fractures of which are Shown in Fig.* 1.

No.	T.C.	Si.	Mn.	S.	P.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	2.95	2.35	0.46	0.08	0.79
2	2.90	1.03	0.46	0.24	0.67
3	3.58	2.70	0.80	0.06	0.34
4	3.52	2.53	0.97	0.03	0.06
5	2.67	7.13	1.06	0.02	0.06
6	3.18	1.92	0.36	0.04	1.75
7	2.63	1.54	2.31	0.04	0.15
8	3.26	1.61	1.75	0.03	1.35
9	3.59	2.28	0.79	0.06	0.36
10	3.57	2.08	0.80	0.07	0.35
11	3.60	3.13	0.78	0.02	0.71
12	3.22	3.18	1.16	0.04	0.97
13	3.03	4.35	0.70	0.01	1.65
14	3.84	0.95	2.05	0.03	0.56
15	3.86	1.49	2.00	0.03	0.55
16	3.86	1.65	2.07	0.03	0.55

The only special irons which are included in the group are No. 5, which is a high-silicon hematite and No. 7, which is a refined low-carbon pig-iron (Total carbon 2.63 per cent.) and all the pigs are sand cast and differ little in size. No. 1 closely resembles No. 14, yet the silicon content is 2.35 per cent. The total carbon in numbers 1, 2 and 7 is quite different from the total carbon in No. 14, yet numbers 1, 7 and 14 are almost identical in fracture, but whether the fracture expert would be able to determine this by visual examination the writer is not prepared to say. Again, if one compares No. 8 with No. 16 how can one deduce the similarity in silicon content. Numbers 5, 6 and 11 could certainly be judged as having almost identical fractures, yet reference to Table I shows the rather wide differences in analyses. It is also impossible to tell differences in manganese, phosphorus, etc., and it is truly fortunate for the man who mixes by fracture that the analyses of most of the common grades of pig-irons remain fairly constant. This is especially the case with medium silicon phosphoric irons commonly classed as No. 3 foundry irons.

So-called refined irons have a definite sphere of usefulness in certain classes of work, but they should only be to a rigid specification and used only in foundries where the mixing and melting operations are definitely and accurately controlled. Often they can be dispensed with by the judicious use of low phosphorus pig-irons mixed with the correct proportion of steel scrap, the silicon and manganese being also suitably regulated. However, in some cases where very low silicon low total carbon iron is required in the final product, refined irons are very useful. A suggested specification for such irons is as follows:—

Total carbon 2.3 to 2.6 per cent. or as required. It is now possible to get one brand of refined iron with total carbon down to 1.8 per cent. Silicon 1.0 to 1.2, or as required, but for irons with under 2.0 per cent. silicon the limit range should certainly not be greater than 0.2 per cent. Sulphur not over 0.05 for low-silicon ranges, and not over 0.03 for ranges with over 2.0 silicon; phosphorus not over 0.15 per cent. or less for very special purposes; manganese 0.8 to 1.1 per cent., or higher ranges as required. It should be noted where very low phosphorus irons are used for special purposes they must not be mixed with scrap or remelt of unknown quality. It is futile, from an economic standpoint, to buy very low phosphorus irons for mixing purposes when irons with, say, 0.2 to 0.4 per cent. or even 0.6 per cent. phosphorus are as a general rule so much cheaper.

There are still one or two well-known brands of genuine cold-blast iron and the writer has quite an open mind as to the value of these. Hot-blast pig-irons, as a whole, are inferior to the old cold-blast irons, yet the reason has not so far been scientifically explained. There seems to be some proof, and experience certainly appears to point in the direction of the fact that cold-blast irons possess inherent properties which the process of remelting in the cupola does not entirely destroy. It may be that the slow-reduction leaves the free carbon, which is the only element present in cast iron, in a peculiar physical condition the particular properties of which are not lost on remelting. However, it is usually very difficult to get direct and definite comparisons between castings made entirely from cold-blast pig-iron and castings off the same pattern made exclusively from hot-blast irons, the final chemical composition being identical in each case. It is useless to make comparisons between castings made from cold-blast irons and castings made from hot-blast irons having vastly different chemical compositions even if they have been made to the same pattern. If cold-blast iron is available at a reasonable price then its use in high-duty castings may be warranted, but the writer has known founders who are in the habit of using 5 or 10 per cent. of cold-blast iron in mixtures, the remaining components of which consisted entirely of common phosphoric pig-irons and with very low-grade scrap and remelt. This appears to the writer to be analogous to putting a few gallons of distilled water in the Atlantic Ocean in the hope of considerably modifying its salinity.

Some idea of just how closely pig-iron manufacturers can and do supply material to reasonable specifications is shown by reference to Table II. It will be seen that most of the consignments are reasonably close to the specification, while some are wonderfully regular from one consignment to another. Brand C is given as an example of the proverbial black sheep which occasionally enters the fold. The supplier of this particular parcel talked glibly of average analysis. The makers of pig-iron should be given clearly to understand that individual samples of any consignment will be expected to conform to the specification limits, a reasonable tolerance being allowed to cover errors of sampling, errors of analysis, etc. For example, if the limits of silicon in a pig-iron be specified as 1.4 to 1.6 per cent., the tolerance should cover 1.35 to 1.65 per cent., while in the case of limits, say, 2.5 to 3.0 per cent. of silicon the tolerance might be extended to cover 2.4 to 3.1 per cent. as an extreme case. The examples quoted in Table II have been selected as typical examples of pig-irons supplied to reasonable specifications during the years 1924, 1925, 1926 and 1927, British pig-irons supplied during the coal-strike period being excluded. It is only fair to state that the great bulk of the material which has passed through the writer's hands during that period has been reasonably near to specification. The particular brands used vary very considerably from time to time, as ultimate economic value of the article is the deciding factor in the selection of any brand to any specification.

What is an Average Element Content?

Some sources of supply will be found notoriously bad, but these are easily eliminated, as it is the writer's custom never to give a so-called black sheep a second trial unless absolute conformation to specification is guaranteed. An interesting case already mentioned is that of the single consignment of brand C. The suppliers had a sample taken from a number of pigs, the drillings mixed and analysed for silicon (which was the constituent in dispute). As the silicon content of this mixed sample happened to come out at 1.43 per cent. (a figure which both the referee and the receiving analyst agreed to be correct) they (the suppliers) claimed that the average analysis was up to specification, although the pig-iron was useless for the purpose for which it was bought, the silicon content in individual pigs ranging from 1.12 per cent. up to 2.73 per cent. Although the consignment was only a small one of 50 tons, as a matter of interest, no less than 25 pigs were sampled and analysed individually, the silicon contents being as follows:—2.08, 2.28, 2.70, 1.38, 2.30, 1.26, 1.34, 1.12, 2.49, 1.87, 1.26, 2.20, 1.85, 2.47, 1.38, 2.48, 2.73, 1.14, 1.13, 1.28, 2.45, 1.36, 1.87, 1.13, and 1.26 per cent., the percentages being given in the order of taking the samples. This claim of average analysis could conceivably

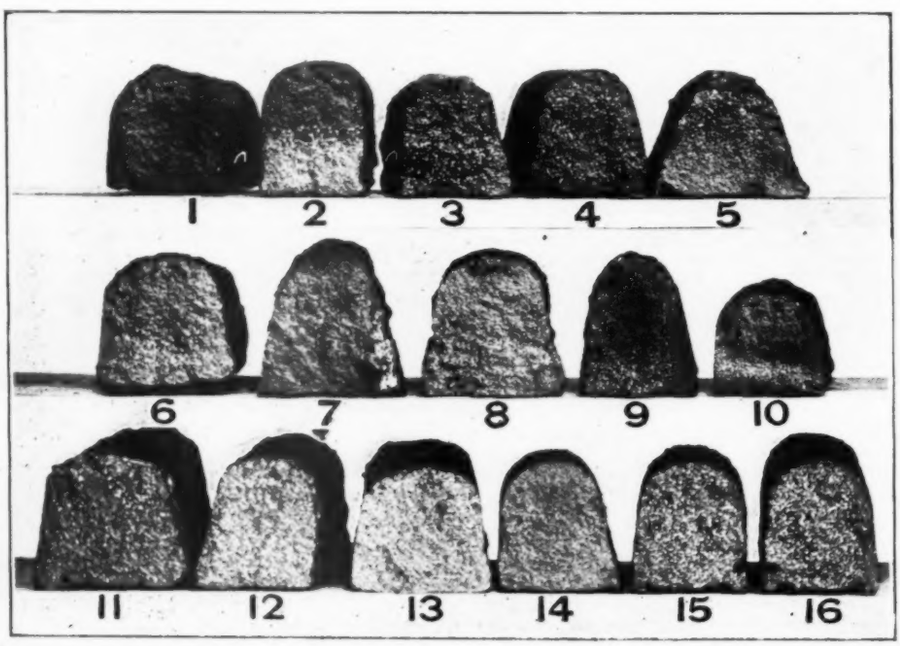


Fig. 1.—Fractures of Pig-iron of the Composition as Set Out in Table I.

cover a case where pig-irons with silicon ranging from 1 per cent. to 7 per cent. could give an average analysis of, say, 3.2 per cent., and be classed as conforming to a specification wherein the silicon limits were 3.0 to 3.5 per cent. Such a state of affairs would be absurd, and the sooner buyers of pig-iron insist on the analyses of individual pigs being within the specification the better it will be for British foundry practice.

Further reference to Table II will show that a complete consignment of brand D, dated July 2, 1924, was well outside the specification as regards silicon and manganese. The suppliers on investigating the matter frankly admitted that the wrong pig-iron had been sent, and compensated the buyer accordingly, but how many times does this happen in foundries where there is no control? Even the smaller foundries should order pig-irons to analysis, because it is a simple thing for them to sample the iron on arrival and have it analysed.

The first and last items on Table II are also interesting, as they are both refined irons, but whereas "A" always comes along well inside specification, "I," even in small tonnages, has proved so unreliable that it is no longer used. On the other hand, the writer has known the makers of "A" to say, "We are sorry we cannot supply you with silicon 1.5 to 1.7 per cent. from stock, but we can do 1.4 to 1.6 per cent.," and up to the present the writer has failed to find them wrong.

Buying and Using Ferro-Alloys.

When one comes to deal with the ferro-alloys the question of specified composition does not matter quite so much in that the material is usually purchased at so much per unit above or below the basis, and consequently the material nearly always contains exactly its declared percentage of alloy constituent. The physical condition and melting points of such materials are important. It is wasteful to charge material which is only suitable for ladle additions directly into the cupola. Ferro-silicon, ferro-manganese, ferro-titanium, ferro-nickel, and ferro-chrome are the chief additions used, the two latter being used to give definite alloy cast irons. If nickel is to be added to the metal stream or to the ladle it can be added very conveniently in the form of "F" shot containing a certain percentage of silicon, which lowers the melting point. However, the writer prefers to add nickel direct to the cupola in the form of 25 or 50 per cent. ferro-nickel ingots. Ferro-manganese for addition to the cupola is best bought in the form of massive ferro-manganese 60 or 80 per cent. grade. Ferro-silicon, being such a brittle alloy, is difficult to add economically to the cupola. A much better system is to add silicon in the form of 7 or 10 per cent. silicon hematite. High-carbon ferro-chrome is often only obtainable in small grades, but, as this is the cheapest form, it may be advantageously weighed up in 5-lb. lots and cast into rough shapes with plaster of Paris.

In conclusion, the writer would like to impress on foundrymen and foundry buyers the necessity for purchasing the basis raw materials for the manufacture of grey cast irons with the greatest care, and always keeping in view the true economic values of the materials. If all foundries purchased pig-iron to reasonable yet accurate specifications pig-iron manufacturers would soon fall into line (as many have already done), and the small man would be protected as well as the large.

Table II.—*Comparison of Pig-Iron Consignments with Specification.*

Designation.		Analyses of consignments.						Specification called for.				
Brand and weight of consignment.	Date of consignment.	No. of samples.	Total carbon. Per cent.	Silicon. Per cent.	Sulphur. Per cent.	Phosphorus. Per cent.	Manganese. Per cent.	Total carbon. Per cent.	Silicon. Per cent.	Sulphur. Per cent.	Phosphorus. Per cent.	Manganese. Per cent.
A 50 tons ..	17/11/26	12 Highest	2.62	1.61	0.038	0.011	1.03	2.3 to	1.5 to	0.05	0.15	0.8 to
		Lowest ..	2.32	1.54	0.022	0.08	0.72	2.6	1.7	max.	max.	1.1
A 50 tons ..	8/1/27	8 Highest ..	2.55	1.67	0.056	0.12	0.93	Do.	Do.	Do.	Do.	Do.
		Lowest ..	2.42	1.56	0.042	0.10	0.85					
A 50 tons ..	31/9/27	8 Highest ..	2.55	1.62	0.041	0.09	0.94	Do.	Do.	Do.	Do.	Do.
		Lowest	2.34	1.48	0.032	0.012	0.86					
B 100 tons ..	4/10/26	8 Highest ..	3.77	3.29	0.036	0.70	0.68	3.5 to	3.0 to	0.01 to	0.5 to	0.6 to
		Lowest ..	3.45	3.08	0.024	0.68	0.64	4.0	3.5	0.03	0.7	0.9
B 100 tons ..	27/1/27	4 Highest ..	3.54	3.44	0.034	0.72	0.89	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.48	3.33	0.032	0.65	0.78					
B 80 tons ..	18/8/27	8 Highest ..	3.71	3.44	0.033	0.67	0.78	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.53	2.94	0.026	0.56	0.72					
C 50 tons ..	3/6/27	25 Highest ..	3.62	2.73	0.058	0.42	0.91	Not over	1.4 to	Not over	0.3 to	0.8 to
		Lowest ..	3.20	1.12	0.032	0.32	0.79	3.3	1.6	0.05	0.4	1.1
D 50 tons ..	2/7/24	8 Highest ..	3.99	2.04	0.016	0.083	0.74	Not over	2.5 to	Not over	Not over	1.0 to
		Lowest ..	3.78	1.85	0.012	0.067	0.62	4.2	3.0	0.04	0.10	1.5
D 50 tons ..	3/10/24	5 Highest ..	4.12	3.10	0.018	0.071	1.42	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.90	2.62	0.014	0.055	1.09					
D 50 tons ..	13/8/25	5 Highest ..	4.43	2.90	0.013	0.069	1.24	Do.	Do.	Do.	Do.	Do.
		Lowest ..	4.09	2.63	0.010	0.048	1.13					
D 50 tons ..	12/7/27	5 Highest ..	3.98	2.73	0.023	0.078	1.31	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.82	2.58	0.017	0.064	1.09					
D 50 tons ..	12/10/27	5 Highest ..	4.44	3.08	0.034	0.083	1.56	Do.	Do.	Do.	Do.	Do.
		Lowest ..	4.12	2.75	0.019	0.054	1.40					
D 50 tons ..	24/1/28	5 Highest ..	4.32	2.86	0.018	0.062	1.26	Do.	Do.	Do.	Do.	Do.
		Lowest ..	4.01	2.53	0.015	0.043	0.98					
E 100 tons ..	23/10/24	10 Highest ..	3.79	3.72	0.051	1.15	1.71	3.0 to	3.25 to	Not over	0.9 to	1.0 to
		Lowest ..	3.32	3.15	0.029	1.02	1.22	3.5	3.75	0.04	1.1	1.5
E 100 tons ..	23/3/25	10 Highest ..	3.46	3.78	0.041	1.09	1.84	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.14	3.17	0.019	0.94	1.45					
E 100 tons ..	9/1/26	10 Highest ..	3.75	3.86	0.052	1.25	1.62	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.10	3.47	0.034	1.04	1.43					
E 100 tons ..	22/4/27	10 Highest ..	3.38	3.58	0.044	1.04	1.48	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.16	3.04	0.031	0.97	1.29					
F 25 tons ..	12/8/25	5 Highest ..	3.78	1.59	0.013	0.069	3.13	Absolute	1.2 to	Not over	Not over	2.5 to
		Lowest ..	3.65	1.23	0.012	0.067	2.92	maximum.	1.5	0.04	0.07	3.0
F 50 tons ..	4/1/26	5 Highest ..	3.95	1.47	0.026	0.095	2.79	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.82	1.16	0.022	0.051	2.48					
F 50 tons ..	22/4/27	5 Highest ..	3.96	1.59	0.043	0.049	3.13	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.90	1.25	0.012	0.042	2.57					
G 100 tons ..	2/12/25	5 Highest ..	3.27	4.49	0.016	1.72	0.38	Not less	4.0 to	Not over	Not over	Not less
		Lowest ..	3.09	4.17	0.005	1.63	0.35	than 2.9	5.0	0.05	1.8	than 0.3
G 100 tons ..	4/2/26	5 Highest ..	3.18	4.76	0.029	1.78	0.47	Do.	Do.	Do.	Do.	Do.
		Lowest ..	2.96	4.32	0.007	1.66	0.29					
G 100 tons ..	15/3/27	5 Highest ..	3.17	5.00	0.049	1.77	0.36	Do.	Do.	Do.	Do.	Do.
		Lowest ..	3.02	4.65	0.041	1.62	0.32					
H 20 tons ..	2/12/27	4 Highest ..	3.86	1.65	0.029	0.56	2.07	Not over	1.0 to	0.01 to	0.3 to	Approx.
		Lowest ..	3.81	0.97	0.026	0.54	2.02	3.8	1.5	0.03	0.5	2.0
I 20 tons ..	3/2/27	8 Highest ..	3.33	1.53	0.083	0.28	0.56	Not over	1.0 to	Not over	Not over	As high as
		Lowest ..	2.52	1.01	0.019	0.17	0.52	2.9	1.3	0.06	0.25	possible for the brand.

An Example of Modern Sand-Blasting Equipment.

In the minds of many people sand-blasting is still associated with the thought of clouds of dust. How far this is from the mark nowadays may be judged from Fig. 2, which shows a modern enclosed and self-contained plant in a railway workshop. This particular installation is for cleaning sheets and plates, but similarly enclosed and automatic machines are built specially for foundry requirements.

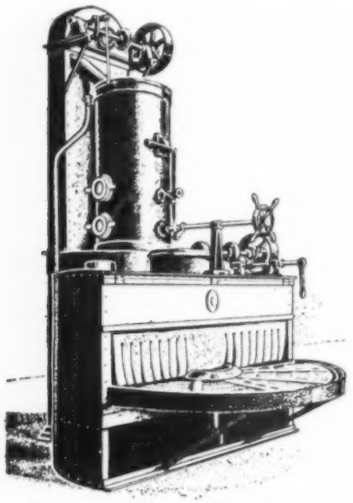


Fig. 1.—Rotary Table Machine.

The advent of the automatic sand-blast machine has, in point of fact, revolutionised sand-blasting. Not only have the old inconveniences disappeared, but a point of efficiency has been reached which makes modern sand-blasting apparatus as essential to the equipment of a well-ordered foundry as the tool room is in any progressive engineering works.

There is now no helmeted workman cleaning the castings more or less well under unfavourable working conditions, but an automatic machine, in charge of a lad, turning out thoroughly cleaned castings, and turning them out rapidly.

The types of machines which are of more particular interest to founders are the sand-blast tumbling barrel and the rotary table machine, the former for cleaning small castings and the latter (Fig. 1) for dealing with medium-sized castings.

Comparatively fragile castings can be handled in the tumbling barrel machine, as the barrel rotates very slowly (one or two turns in a minute), the object of the movement being simply to bring all pieces under the action of the sand jet, and this jet, coming from a rocking nozzle, sprays across the width of the barrel.

In both types of machine the spent sand is returned mechanically and positively by means of a bucket elevator, and is sieved *en route*.

It is obvious that all pipes conveying the stream of sand and air under pressure are liable to wear, and for this reason it is highly desirable that pipes should be kept as short as possible and with a minimum number of bends and elbows. This is an important point which should not be lost sight of in choosing a machine.

In the illustration of the rotary table machine (Fig. 1) it will be noticed that the sand tank is built directly above the table, and with this particular machine the feed pipe between the tank and the nozzle is only a foot in length.

It will be seen that a rubber curtain crosses the table, and it is behind this curtain that the actual sand-blasting takes place. Nozzles with a circular movement compensate for the different diameters of the table, so that all the castings are evenly sprayed, and the jets are slightly inclined from the vertical, enabling the sides of the castings to be cleaned at the same time as the upper surface. As the table turns slowly round the castings re-appear in front of the machine, and are either removed and replaced by others, or they are turned over for the underside to be cleaned, according to requirements. The operation is to all intents and purposes continuous, so that round about 3-tons of castings can be dealt with per day.

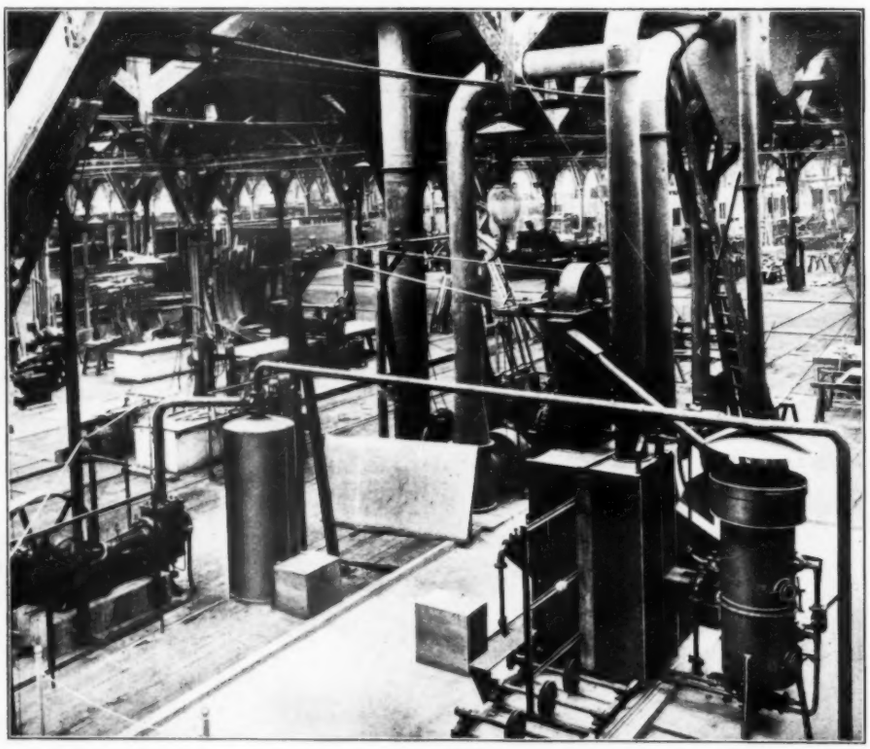


Fig. 2.—Sand-Blast Plant in a Railway Shop.

To return to the first point, with these modern enclosed machines the sand and dust are eliminated and the operator works from outside the machine under healthy conditions. The machines illustrated are by the Midland Sand Blast & Foundry Supplies Company, Limited, Warwick.

Common Defects in Brass.*

The origin of the usual defects met with in manufactured brass, whether in sheets or bars, may, at the first glance, seem obscure. Nevertheless, these may be divided into two classes, namely, those which come from imperfections of the metal in the ingot, and those which are brought about by subsequent working. With a little care one may generally refer a fault to one or other of these sources. The commonest faults due to later processes are sufficiently diverse. Ruptures may be due to excessive cold hammering. A rough surface, after certain operations, such as drawing, may be due to the preliminary heating being overdone, causing the grain to grow abnormally. The flaws that develop with age due to the neglect of eliminating tensions set up during working by annealing at a low temperature. These faults are easy to recognise by physical and microscopical tests. When the metal does not stand up to its work at a cold of normal intensity the cause must be sought in incorrect composition or inherent defect. Other factors must be taken into consideration, such as lubrication and adjustment of tools. It is easy to make sure that these points are correct by a trial on a correct metal. Other faults, such as red spots, may appear, and, though some effort has been made to investigate this matter, the cause is not thoroughly known. Faults inherent in the ingot show up as blisters, incrustations on strips, holes and porosities. They are all due to manner of casting. Blisters come from ingots cast at too low a temperature, where the viscous metal solidifies rapidly, imprisoning gases evolved from the coating on the mould. The resulting cavities are more or less spherical, their walls being covered with a graphitic layer. Too low casting temperature affects appreciably the mechanical properties of the brass. To avoid this the metal should be cast at 1,130 to 1,150 C. Another fault more difficult to eliminate is that due to contraction in cooling. While the cavities caused by casting at low temperature are distributed throughout the mass, at surface as well as at centre, those arising through the contraction are of irregular shape and usually at the centre of the ingot. To avoid this one may, in accordance with theory, make the metal solidify more slowly under a greater head of liquid metal in the gate. Thus the contraction defect is concentrated in one cavity at the head. The normal method of avoiding this fault is to cast at sufficiently high temperature. The contraction cavities, when numerous and serious, reveal themselves later as porous regions and discoloured spots. The condition of the surface of the ingots is also affected by the speed of casting; the quicker, the fewer surface faults (apart from the state of the mould). It is important to have the surface in good condition, for, if the bars are to be laminated and machined, there is a saving in time and metal if there are neither pittings nor wrinkles. These faults reveal themselves in course of the working, but remain concealed if the casting is not machined. Most of the above defects only show when the metal has gone through various stages of working, and has been transformed into sheets, strips, wires or rods. Sometimes they are only seen at the final stages, and in weak sections. It is, therefore, of the utmost importance to have the castings sound, and to remelt, without hesitation, all defective ingots. This means a smaller loss than to have to condemn the metal after it has undergone a number of operations. Brass does not present, by nature, more faults than other metals or alloys, but it is worked up in many and complicated processes that the slightest defects are apt to come to the front.

* Translated from "La Pratique des Industries Mecaniques

Foundry Pig-Iron.

By Robert Fowler, M.Inst.M.M. (America).*

There has been great tendency through the technical Press to express and discuss many opinions on the great irregularity in the chemical composition of pig-iron delivered to the founders.

These irregularities are chiefly ascribed to the producer of the metal, without any serious thought on the part of many, as to the many difficulties during the reduction process, seen and unseen, which are daily occurring, and which have to be remedied very quickly to keep the product so as to become a useable material within the foundry.

True, there is no excuse for delivering to the foundries consignments of pig-iron of abnormal analysis, as the supplier must have the knowledge as to the chemical composition of the pig-iron that is being supplied. It is therefore the object of this article to give a brief *résumé* of some of the more important difficulties that have to be encountered in the production of foundry iron, and which, in the writer's opinion, cause these variations in the chemical and physical composition of the product as it leaves the furnace.

In the production of foundry pig-iron the blast-furnace staffs are expected to produce an iron of a certain analysis and fracture within close limits. This cannot be accomplished as readily as with steel manufactured, either by the open-hearth or Bessemer processes, where the bath of molten metal is of easy accessibility, and where the constituents of the bath can be regulated to produce the desired resulting product.

The casual observer may take the blast-furnace to be an easy-going and easily-regulated piece of apparatus, but this idea can be cast far distant from their thoughts. It is an unwieldy piece of apparatus from which is expected so much tonnage per square foot of hearth area, per unit of time. Engineers have performed valuable work in constructing the modern furnaces large enough, and all the accessories more to perfection, but it remains more upon the abilities of the metallurgist for present and future progress.

The great key-note to success in the manufacture of foundry pig-iron—and also in any other grade of iron or alloy—is uniformity. It is essential to have uniformity in all things, remotely or otherwise, that have anything to do with the furnace. Uniformity in working conditions, the size of materials used and their chemical and physical condition are the chief essentials to successful operation and desired products being attained. It is also highly essential that the distribution of the raw materials should be as uniform as possible, radially and axially within the furnace as it is possibly to be acquired. Very small irregularities in any of the above conditions are enough to upset the delicate balance, operation and product of the furnace.

It is, of course, not practicable to obtain the materials—coke, ores, and fluxes—for use in the furnace, of a definite uniform size, density and chemical composition, but one can to a degree come near to this condition by special means of preparation.

COKE.

Coke is the only material that is artificially manufactured that enters the furnace. The other raw materials which form the burden of the furnace with the coke as a fuel, apart from any mechanical preparation they may have been subjected to, must be taken as they are delivered to the furnace stock-house.

The coke alone can be varied in its quality within wide limits. In the present day by-product coke oven there exists an apparatus more capable of adjustment to produce a definite, uniform, and regulated coke. The fuel may be made more uniform, both chemically and physically, by the efficient washing, mixing, grinding, compactness in coking chamber and the rate and temperature of the carbonisation of the coal.

The physical condition and chemical purity of the coke for use in the blast-furnace are of the utmost importance. It should be strong but not of great density, so that it destroys the cellular structure. The strength should be such that it will prevent the formation of fines, and also withstand the abrasion and crushing effect of the burden whilst passing through the furnace.

The density and cellular structure of the coke has great bearing on the amount of surface that it presents to the action of the oxygen of the blast, thus either raising or lowering its degree of combustibility. In one case the cells may be small and the cell walls thick and strong, whereas in another the cells may be larger and the walls thinner and weaker. In consequence of the difference in the structure of different types of coke, the cubic volume of coke presented to the action of the blast will differ very widely. It will at once become apparent that the rate of combustibility of the coke controls both the quantity of the iron and, to a certain degree, the quality of the pig-iron produced.

By screening methods prior to the coke being charged into the furnace, as much as 10 per cent. of fines and breeze may be removed. This breeze acts as a partially inert material while passing through the furnace, as far as its thermal properties are concerned. It also offers resistance to the upward passage of the gases, impedes production and causes derangement of the working of the furnace.

Influence of Condition of Coke.

There is nothing that disturbs the balance and uniform working of the furnace and its resulting products more than a soft, friable coke with a high ash-content. The resulting fines caused by abrasion and crushing of this type of coke during its descent through the furnace, along with the charging of any breeze or fines that may not have been extracted, will soon lodge on the walls and generally on the bosh of the furnace in the vicinity of the bosh level, and will soon produce a scaffold which, if immediate steps are not taken to deal with it, will eventually cause the furnace to hang and stop production.

Where the coke is charged into the furnace by volume, its size and density is of the utmost importance. Variations in the size and density will naturally give an equal variation in the weight of coke charged for the same volume. In consequence of these variations in the size and density of the coke charged per volume, there is a great tendency for the fusion zone within the furnace to rise or fall as these variations occur.

When the coke is of large size the interstices of the charge in the furnace will be greater, and there is a tendency of the fine ores or flux to pack these interstices so as to cause an excessively dense stock column. In the case of small coke, where the density and strength are all that is desired, it presents the difficulty of its ability to keep the interstices of the stock column open enough to allow of a uniform and easy path for the ascending gases over the entire section of the stock column.

Where the stock column is so dense, it is obvious that the blast pressure is forced to make a local passage through this dense mass of material, which necessarily does not prepare, pre-heat or reduce the other parts of the stock column, thus causing a derangement of the working within the furnace.

As to the chemical analysis of the coke, this is a matter of less scrutiny where the coke is delivered from one source only, because the carbon, ash and sulphur content is approximately fixed within narrow limits as noted by the daily analysis. The moisture content of the coke may vary due to over-quenching or weather conditions, but where the fuel is charged by volume this is not a serious handicap. Where the fuel is charged by weight then the moisture content must be closely attended to, as the weight of carbon charged for the reduction of the ores will positively be less where the moisture content is high. This will necessarily have a very detrimental effect upon the quality of the iron produced.

Where the percentages of the constituents of the coke are within the desired limits, there appears to be no unusual variation in practice during the uniform working of the furnace.

Thus, the physical character of the coke may be the real keystone to uniform working, and even with satisfactory ores and flux, and most careful application of furnace construction and supervision of all operators, inferior coke is productive of irregular operation and off-grade pig-iron being produced.

IRON ORES.

The principal iron ores of commercial value are the oxides, Magnetite ($FeO.Fe_2O_3$) and Hematite (Fe_2O_3); the hydrated oxides, Turgite, Goethite and Limonite, of which the latter is the principal and has a chemical formula $2Fe_2O_3.3H_2O$; and Siderate, the carbonate or iron, $FeCO_3$.

The degree of reducibility of an iron ore mainly depends upon its density, which characteristic is not readily altered except under special preparation. The degree of reducibility of the main ores are in the order as follows: Magnetite, with a specific gravity of 5.2, the densest and hardest ore to reduce. The red hematites come next in order with a specific gravity of 4.5 to 5.0, followed by the brown hematites of from 3.6 to 4.0.

The Carbonates are fairly easily of reducibility after they have been subjected to the calcination process, which is applicable to this class of ore to drive off the excess of CO_2 which they hold in combination. Iron ores are the most important of all the raw materials charged into the furnace that need careful preparation, owing to the extremes in mechanical, physical and chemical condition.

Irregularity in the chemical and physical condition of the ores introduce obstacles to uniform practice which have to be obviated to prevent irregular working, slipping and off-grade production. These handicaps to safe practice, introduced by the character of the ores is dependent upon their size and uniformity.

The chemical and physical properties of ores are improved by careful mixing, magnetic concentration, crushing, roasting, washing, drying, nodulizing and sintering.

Unreduced Material Causes Off-grade Iron.

Ores in the form of large lumps may pass through the furnace without being completely reduced, and occasionally some of the dense, hard ores are insufficiently crushed for use in the furnace or are charged in excessive amounts, so that it passes through the furnace and reaches the reduction zone in an unprepared state. Thus the presence of these large lumps or an excessive amount of dense ores which are only partly reduced, passing beyond the point where indirect reduction takes place, and coming to where the direct action of the carbon of the fuel must take up the unfinished work, will eventually lead to the chilling of the hearth of the furnace, a scouring cinder and in consequence an off-grade iron.

In cases where this direct reduction is in high proportion to the indirect reduction, the equilibrium of the fusion zone is deranged and it results in producing an insufficiently carburised and smelted iron, and also in partially reduced, and in consequence relatively cold ore being thrown into the hearth. Ores when in this state demand a higher heat to bring them to a normal working of the furnace. When this condition arises it may lead to a result of tuyères becoming ironed up, with a consequent loss of cooling equipment, chilled tapping hole, with high hearth bottoms, which presents great dangers and difficulties.

When once a furnace becomes in this condition it may mean days or even weeks of hard work to restore it to its normal condition again.

Therefore, ores that are so large, dense or difficult to reduce so that it comes through the furnace without sufficient indirect reduction, require further crushing to maintain uniform and safety during the reducing process.

Where the burden of the furnace is made up of fine ores, we have similar conditions to meet as in the case of a burden composed of large or dense ores. Given that the lines of the furnace are well designed and that the distribution of the materials are satisfactory, then the most skilful practice will at times not suffice to overcome the

* The author is on the staff of the Indian Iron and Steel Company, Limited, Hirapur Works, Burnpore, via Asansol, Bengal.

erratic working of such burdens whilst passing through the shaft of the furnace.

SCAFFOLDING.

There are several factors which contribute to this irregular working. Where the burden is composed of a high proportion of these fine oxides, there are induced, owing to any variation in the distribution of the charge or its rate of descent through the furnace, deposits of very finely segregated carbon, which cause the column of materials to expand in the upper inwall of the furnace and consequently cause the burden to hang. The result of this hanging, and the frequent slipping of the burden in the upper zones of the furnace, causes great irregularity in the charging of the burden and which relatively aggravates the tendency to further irregular working to which the furnace is inclined.

Lower down in the shaft of the furnace this hanging of the charge is also caused by the fine materials which constitute the burden, creating an excessive and highly dense stock-column by reason of their easy reducibility by the action of the ascending reducing gases which consequently increases their fineness until it becomes a pasty agglomeration. Due to the denseness of such a burden in this condition, the ascending gases can only pass through such a mass with great difficulty, and consequently finds the most accessible outlet and causes irregular channels through the stock column. The tendency of the fine materials of the burden is to further fill and pack these channels formed, until the currents of ascending gases are still further diminished, and where the channels are still open, it prevents great possibility of the currents of gases being diverted from these segregated paths formed, until the column of stock is loosened, in furnace parlance, "by shaking or slipping the furnace." Where this channelling exists, it allows the currents of gases to pass to the top of the furnace without giving off their sensible heat, which is so essential to prepare the materials on their descent through the stack, and those parts of the charge which are adjacent to these streams of highly-heated and rapidly-ascending gases, become in a plastic condition. Wherever this plastic material comes into contact with the inwall of the stack it congeals and adheres to the relatively cool surface of the inwall, and will in all probability result in scaffolding, hanging, and consequently the slipping of the burden.

When the materials of the burden have attained this condition and have become an agglomerated mass, and also those parts of the column that have become so dense that they were impervious to the action of the ascending gases, we often find them arriving at the melting zone of the furnace in an unreduced and insufficiently prepared state after they have been dislodged by the "shaking or slipping" of the burden.

Fine ores when precipitated into the hearth in this unreduced and unprepared state, prduces all the derangements and dangers applicable to a chilled hearth, high hearth bottom, chilled tapping hole, loss of cooling equipment and off-grade iron which are also characteristic of the difficulties produced by the use of dense difficult reducible, and ores of too large a size.

Where there are ores that are in a fine state one can remedy their evils by preparing them by reverse methods to that employed in preparing lumpy and dense ores, by increasing their size through either nodulising, briquetting or the sintering processes being applied.

In practice it has been found that ores of about 4 in. in size are most beneficial to maintain the uniform and most economical working of the furnace.

FLUX.

The universal flux used in blast-furnace practice is either the carbonate of lime ($CaCO_3$) as limestone, or the double carbonate of lime and magnesia ($CaOCO_2$-$MgOCO_2$), in the form of dolomite.

The flux which constitutes part of the burden is an indispensable substance, and the amount that may be used is dependable upon a number of factors, and can be varied within a wide range without deranging the working of the furnace. Usually these fluxes influence the least irregularities in practice of any of the materials which constitutes the charge.

The principal impurities of the fluxes are silica (SiO_2), alumina (Al_2O_3), iron (Fe), and sulphur (S). A track should also be kept on the phosphorus (P) content in the ores, and especially when making low-phosphoric iron.

The silica occurs in the free state as sand, or combined with alumina, as silicate of alumina (Al_2O_3-$2SiO_2$-$3H_2O$), while alumina only occurs in the latter form.

Iron (Fe) may occur as the carbonate ($FeCO_3$), oxide (Fe_2O_3) or the sulphide (FeS).

Sulphur (S) may occur as the sulphide of iron or as the sulphide of calcium (CaS) or magnesium (MgS).

All the foregoing impurities will be found in the flux as gangue. This gangue should be as small a percentage of the flux as possible, as the higher this amount is, the less will be the available efficiency of the flux. Irregularity in the chemical composition of the flux has a very detrimental effect upon the grade of iron produced, and in consequence it is of the utmost importance to have the flux in its chemical composition as uniformly as possible.

The varying percentages of the impurities in the flux had also great disadvantages in so altering the chemical balance of the burden in passing through the furnace, so that quite a different quality of iron is produced from that which was expected.

Incorrect Fluxing Requires Additional Fuel.

It is well known in metallurgical work that the silica and alumina are two-fold detrimentally in operation. First, they reduce the percentage of calcium and magnesium oxides in the flux, and, secondly, a definite quantity of the available fluxing oxides are required to flux these impurities and form a slag.

It is quite evident that a certain amount of fuel is needed to raise the constituents of this slag being formed, to its heat of formation. This extra fuel which is needed, is in addition to the fuel already alloted to the burden for the production of a certain grade of iron, and to produce the heat necessary for the slag formation from the impurities in the ores, flux and fuel of the burden.

Therefore, it is at once apparent that where this extra quantity of slag is being formed from impurities that are above the normal percentages in the flux, the extra fuel needed for its formation is supplied from the fuel already allotted from calculations to produce a particular grade of iron. Thus the efficiency of the fuel for a particular burden is greatly reduced and altogether a different quality of iron produced from that which was expected. On the other hand, where the impurities are lower in amount than normally expected, the slag will become higher in its basic constituents than is allowable for the smooth working of the furnace, and owing to this high basicity will cause the furnace to work irregular owing to the pasty condition of the slag formed within the furnace.

Size Determined by Refractoriness.

The chemical composition of the flux used in the burden should therefore be as uniform as possible to aid the uniform operation of the furnace and for the production of a certain grade of iron.

The sizing of the flux is also of the utmost importance, so that a uniform material is charged into the furnace in a similar manner to that previously mentioned in regard to the size of ores. The same principle applies to the mechanical condition of the flux as in the case of ores, although the effect is in a much smaller degree. The size of the flux should be dependent upon its refractoriness. This is on account of the various temperatures at which the carbon-di-oxide (CO_2) is expelled from the different varieties and sizes of flux.

In cases where the flux comes down to the tuyeres in excessively large pieces, there is need for finer crushing. This should not be crushed so finely that all the CO_2 is expelled before the flux has passed through the reduction zone.

The charging of fine flux will produce the same irregularities as in the case cited for ores. Other factors in relation to the flux which may cause irregularities, are the charging of a large amount of fine dust and dirt which is usually accompanied with the flux in the storage bunkers. By screening and washing the crushed flux, the fines, dust, and the greater part of foreign earthy matter will be greatly eliminated.

THE BLAST.

The only other raw material that enters the furnace and which is so important for the reduction of the iron, is the blast. Through this medium the oxygen is supplied, which is so necessary for the combustion of the fuel. The quantity of air required in modern blast-furnace practice is very considerable. A modern furnace producing from 500 to 700 tons of pig-iron per day requires approximately from 40,000 to 48,000 cub. ft. of air per min., or a total weight of from 2,075 to 2,493 tons per day at 32 deg. Fah. and 760 m.m. This weight of air delivered to the furnace is approximately equal to from 20 to 30 per cent. more than the weight of all the raw materials charged into the furnace during the same period of time.

This weight of air forced into the furnace is dependent upon the weight of fuel to be consumed over a period of time, and the amount of iron that has to be reduced during this period so as to maintain a state of equilibrium within the furnace and produce the pig-iron to a certain chemical analysis.

Thus only a definite volume of air can be delivered to the furnace to produce a certain grade of pig-iron with a corresponding ratio of fuel to the iron bearing materials of the burden.

There are three variables in connection with the amount of air blown into the furnace, and either one or all conjointly may contribute to producing irregularities and altogether a different grade of pig-iron than that which is desired. These variables in order of magnitude are, humidity of the atmosphere, temperature of the blast, and the volume and pressure of the blast as delivered to the furnace.

Humidity of the atmosphere is the most important variable, and one over which there is no control unless resort is made to physical or chemical preparation to relieve the air of its hygroscopic moisture before being delivered to the furnace.

It is well known that the humidity of the atmosphere varies from hour to hour, and any necessary adjustment that may be calculated as required to meet any particular percentage of humidity as it occurs, is not possible of being applied in actual practice, as it takes from 10 to 14 hours from the charging of the burden before it actually reaches the zone of combustion.

When using air that has a continual change in its degree of humidity, chance will play a great part in keeping the furnace working to normal conditions and in producing the quality of pig-iron desired. The amount of water vapour entering the furnace with the air is very large when the degree of humidity is high, and in consequence it has a great cooling effect upon the zone of combustion owing to the amount of heat required for the dissociation of the said water vapour. In the case of a furnace being delivered with from 40,000 to 48,000 cub. ft. of free air per min., and with 5 grains of water vapour per cub. ft. we have going into the furnace from 28.5 to 34 lbs. of water vapour per min.

The air entering the furnace through the tuyeres consists of approximately 23 per cent. oxygen and 77 per cent. nitrogen by weight, along with which is carried the varying amounts of water vapour as cited above. Thus a great weight of inert nitrogen passes through the furnace and serves no useful purpose in any of the chemical actions occurring within the furnace, other than that of absorbing a certain quantity of heat in the reduction zone, and giving it off again at higher levels whilst passing through the furnace, and finally when discharged from the top of the furnace as part of the gases, carries away with it a considerable quantity of heat.

Importance of Continuous Flow.

The oxygen of the air is the element with which the furnace operator is mostly concerned, as it is by its action with the incandescent fuel at the tuyeres that the reduction of the iron is completed. It is therefore highly important that the volume of air should be delivered to the furnace in as a continuous flow as possible and as free from pulsations as practicable.

With a definite volume of free air delivered to the furnace it is found that there are varying weights of oxygen delivered, owing to the varying temperature, density and humidity of the free air. In consequence, the rate of the production of the reducing agent carbon monoxide (CO), is either accelerated or retarded according to the variability of the weight of oxygen in the volume of air delivered through the tuyeres. It will, therefore, be apparent that the rate of reduction of the metal is also accelerated or retarded in relation to the degree of the variability in the mixture of free air delivered to the furnace.

Therefore, with the continual fluctuations in the hygroscopic moisture and gaseous mixture of the air, due to variations in its humidity, density and temperature, there will also be fluctuations in the rate of reduction, and in consequence of this, the pig-iron so produced will vary in its chemical and physical properties also.

In view of this, where a furnace is reducing iron at a high speed, many different qualities of iron are being produced during these variations, and followed by the immediate tapping of the furnace, it is highly probable that the perfect diffusion of the products so produced is very remote.

This, in the writer's opinion, is one of the causes of the varying chemical analysis of the pig-iron which is so often reiterated as being found throughout the same cast of pig-iron.

High Temperature Causes Hanging.

The temperature of the pre-heated blast delivered to the furnace is the one function of operation that can be regulated at will, and under the control of the operator, providing the heating equipment is in an efficient state. For any particular furnace under given conditions, there is a limit to the temperature of the blast that can be utilised to produce smooth and satisfactory working. With any considerable increase in its temperature beyond this limit, there is caused a "pastiness," "hanging" and irregular movement of the stock in its descent through the furnace. The average blast temperature generally ranges between 1,100 to 1,300 deg. F. By the admission or reduction of a quantity of cold blast into the hot-blast main, a uniform temperature can be maintained throughout the period of operation, according to the amount of heat required for the production of a certain grade of pig-iron, the increasing or reducing of the temperature being a matter of judgment on the part of the operator. By this method, any variation that is likely to occur during the period any certain stove is on blast, is eliminated to a very small degree.

In an article of this description it is impossible to do more than touch upon the points of the difficulties which are encountered in the production of pig-iron, but which are so vital to the uniform and economical production of this material. When the furnaceman has done his part, then it is time for the founder to study and make use of the pig-iron placed at his disposal.

This can be attained with the application of scientific knowledge, to bring about the desired results, by careful mixing of these irons. Frequently the furnaceman is often not informed of complaints concerning his iron until it has all been melted up, and then he has no remedy other than to inspect the castings which are claimed to have been made from the iron complained of.

It is well-known that there are many ways in which the original character of the pig-iron can be altered during its re-melting in the cupola, so as to place upon the furnaceman the blame for bad results for which he is not rightly responsible.

Where the founder desires a certain grade of pig-iron to a certain analysis, he will find that it will be delivered to him if he rightly gives the specification of the material he requires for his work. It is, therefore, highly desirable that a closer co-operation between the founder and furnaceman is needed, and a definite understanding as to the exact requirements needed, and all concerned to have a thorough knowledge of metallurgy and of the numerous ways in which the elements appear as beneficial agents or impurities, that may benefit or injure the resulting product, and at times may even unite to destroy the separate effects of each other.

Improving the Small Business.

An Expensive Permanent Staff is Not Always Necessary.

By A. J. Smith.

The small undertaking has of late years acquired a new personality and a new status. Formerly there was no mistaking a small business for anything but what it was. Its relative importance was apparent in every detail of commercial and trading intercourse. Its publicity would usually indicate an amateur hand mastering the elements of advertising, and in the whole of the subsequent negotiations a certain awkwardness would be noticeable which gave a correspondent or probable customer as clear an indication of the size of the business as if he had personally investigated the whole of the modest details of the organisation.

The Present Day.

Contrasted with this state of things, it is now becoming increasingly difficult to distinguish the small from the large undertaking in general trading intercourse without a very close personal knowledge of the industry concerned. The days have passed, or, at any rate, are rapidly passing, when the amateur and rather crude advertisement would be followed by an equally crude and curt letter, when an overseas customer would have to undertake a schoolmaster's task of imparting certain elementary instruction on shipping matters before he could secure his goods, or else have to explain at great length that a documentary draft was not a particularly dangerous form of confidence trick, when, in fact, every stage of the transaction indicated exactly the size of the establishment and many of its shortcomings. Nowadays, on the contrary, the average buyer is constantly being surprised to find that many of his suppliers are not nearly so large or important as he had half unconsciously imagined from the style in which much of their business was conducted. A great deal of the change is due to the increasing number of directions in which it is possible to utilise the expert assistance of outside agencies, and to an increasing disposition on the part of the small manufacturer to make full use of such assistance in developing his business. An appreciation of the fact is growing that it is no more derogatory to call in the expert assistance and experience of an outsider for occasional work than it is to employ a similar class of man as a whole-time worker.

Advertising Example.

Probably the best-known example of the outside expert is the advertising consultant or agent, whose services can be utilised for the design of advertisements, and whose advice can be obtained just as often as required at a cost which is entirely proportionate to the amount of work to be done, and whose expenses cease automatically when there is no immediate need of his services. A consultant of this type is, in fact, a worker or servant who receives no regular salary or subsidy, but who is yet available for carrying out work in a style equal to that of any other manufacturer in the trade, no matter how large.

Something of the same tendency is becoming increasingly apparent in many other departments of commercial activity, particularly on the sales promotion side. The catalogues and general sales literature issued by many small firms nowadays are quite obviously the work of experts, and are in many cases due to the employment of an advertising consultant or the selection of a printer with an advisory or service department who has realised that printing offers a field for constructive work and advice as well as the mere unquestioning execution of an order. In a slightly different field, there are now other agencies which specialise in the preparation of sales letters and the entire work of initiating and conducting a selling campaign amongst buyers in practically all industries. It is merely left for the small manufacturer to issue his instructions in precisely the same way as would the managing director of a large business, and for the outside specialist to carry out the details of the work involved, free from interference with the everyday work of the regular small staff.

Other Outside Specialists.

The possibilities of the outside specialist do not begin and end with the sales promotion side. Nowadays one may encounter quite small manufacturers in any of the main industrial districts of the type who would formerly never trust themselves to quote any price except for delivery "ex works" who will now regularly quote c.i.f. figures for practically any foreign port when the destination of an inquiry is indicated. The improvement in this direction is due mainly to the useful activities of shipping agents, and the example thus set by go-ahead manufacturers working in conjunction with such agencies is undoubtedly setting the pace for more backward competitors, who are finding that ways and means must be found for keying up the efficiency of a small staff to be equal to that of a large business if trade is to be secured in the face of existing competition. Another useful but less known specialist is the railway and transport expert, who, with any volume of miscellaneous traffic, can show his clients a very satisfactory saving over and above the fee charged for his services. In the way of travelling it has been for a long time increasingly common for one salesman on the road to combine the representation of a number of firms, and to depend entirely upon commission as the reward of his efforts. The same principle is occasionally extended to foreign trading, although in the latter case some outright contribution is usually necessary, and the writer has encountered instances of an outside commercial traveller opening up trade with a number of the nearer European markets, such as Holland, Germany and Spain, at a total expense which did not represent more than a small percentage upon the orders secured, and little more than what would have to be spent upon a short English selling tour when the whole of this was borne by a single firm.

On the productive side of industry, one may often find an intricate engineering proposition, such as is represented by a well-designed internal-combustion engine, conforming to the latest practice, produced by a very small firm amongst whose personnel an outsider would hardly have expected to find a man with the necessary experience for the work. The explanation of this and many other similar cases is, of course, the employment of an outside expert for the designs.

Inconsistencies.

The incursion of the specialist is, naturally, apt at first to produce some inconsistencies in a small business. The general style of correspondence, for instance, often strikes an incongruous note following upon the manner in which the publicity and the initial selling correspondence is conducted, but, on the whole, it will be found that the employment of the specialist has the effect of increasing the efficiency of many other departments, which is the true way of progress.

British Industries Fair.

Birmingham Section.

The British Oxygen Company inform us that in describing the cast-iron cutter exhibited at British Industries Fair, which we illustrated and designated a welding torch, we used an Americanism in a wrong sense. We presumed, evidently erroneously, that any cutter using gas could be called a torch, and apologise for the mistake we made.

Radiation, Limited, inform us that the address of Arden, Hill & Company is Acme Works, Aston, Birmingham, and not Essex, as sent out in their Exhibition notice.

Orders for the building of eight vessels—a flotilla leader and seven destroyers—on Wednesday were placed by the Admiralty. Scotland gets four, the Tyne three, and Barrow one. The announcement gave the complete list of contracts as follows:—One destroyer by Vickers-Armstrong, Barrow; two destroyers, Scott Company, Greenock; two destroyers, John Brown, Clydebank; two destroyers, Hawthorn Leslie, Hebburn; flotilla leader, Swan Hunters, Wallsend.

XUM

Foundry Purchasing.—XXI.

By Eric N. Simons.

The subject of purchasing methods bristles with pitfalls for the unwary. There are few buyers who have not their own special notions of how the work of their department should be carried on, and these will regard with scorn any suggestions that do not happen to correspond with their particular fads and fancies. But the risk of exciting disapprobation must be faced. Perhaps the best way of beginning a criticism on foundry purchasing methods will be to give a brief outline of an actual working system, as practised in the buying department of an important north-country foundry, whose invoices for a year total up to some hundreds of thousands of pounds. With this brief outline of an efficient system concluded, it will then be possible to turn to purchasing methods in detail, and consider them from the buyer's point of view.

The department in question is a centralised office, whose inauguration is admitted to have led to the saving of many thousands of pounds for the firm by methods simple and efficient. Each department, whether in works or offices, has a series of symbols to represent its various requirements, so that production costs for each can be analysed with maximum accuracy. Each department requisitions for supplies to the purchasing department, and its written requisition carries the symbol appropriate to the machine or work for which the supplies are required. (See Fig. 1.)

The next step is to record both orders and contracts in such a way as to facilitate reference. There follows the necessity of securing prompt delivery of all goods ordered. This, again, is done by a simple system. A rule of the department is that a definite delivery promise must accompany each quotation. When the order is sent out, a clerk records the order number on the appropriate date card. These date cards are kept in a little cabinet, and if the order is sent out, let us say, on January 29, 1928, and the promise is for three weeks after receipt of order, the card for February 19 is marked with that particular order number. As each day passes, the clerk consults the current date card, and if deliveries of the orders written on it have not been made, he takes out the card and proceeds to write letters or printed postcards pressing for delivery. The card is not put back until definite replies have been received. Vagueness is not tolerated, and any firm specifying merely "a few days," or some similar half-promise, is compelled to be more explicit. If a new promise is made, this again is recorded on the card for the date on which delivery will be made; thus, no order is allowed to escape notice; the system requires the minimum of clerical work, and saves a tremendous amount of time.

The form shown in Fig. 2 is sent to the supplier, and has to be returned with the date of delivery clearly specified on it. This date is then transferred to the date card, and the system takes effect in the regular manner. When completed, both date cards and promise forms are destroyed, unless they contain information of some special kind that it is necessary to keep. There is no point in keeping dead matter.

Requisition.

To be charged to		Date
Symbols	Particulars.	To be ordered from

Signed.....

Fig. 1.—Simple Requisition Form.

The whole of these requisitions, as received by the buying department, are then analysed and classified on lines indicated later. Each of these classifications or sections is supervised by a member of the department under the control of the head buyer. Where similar materials are ordered by different departments, quotations are obtained from the aggregate quantities, and in many instances lower prices are secured than would have been the case had each department ordered separately. After the head buyer has considered the various prices received, and has chosen the firms with whom to place orders, he passes the requisitions to a typist, who from them makes out the official orders.

The orders are not bound up in a book, but are printed as single quarto sheets, each bearing a consecutive number. In addition to the top copy, bearing the printed instructions for the supplier's guidance, three extra copies are taken for internal use. These four copies, taken at one operation, are then distributed in the following way:—

1. The original is sent to the suppliers; (2) the first copy remains in the buying department, and is bound up and filed for reference; (3) the second copy goes to the stores department, or to the receiving official; (4) the third copy goes first to the board of directors for their examination and approval, and is then passed to the requisitioning department as a proof that their supplies have been properly ordered.

In this way, expenditure is controlled by the management in the quickest and most satisfactory manner: the stores department, weighman, or receiving official, knows exactly what goods are likely to be delivered in the immediate future, and by whom; and finally, the department that ordered the supplies has all the necessary particulars to enable it to take up the question of delivery, should it become necessary to do so.

Promise of Delivery.

This form to be filled in by suppliers and *returned at once*. The promise of delivery to be adhered to, as far as possible, in every case.

Full order No.	Date.	Material.

The material to the above order will be delivered on.....192...

Date..... Suppliers.....

Fig. 2.—Form for Delivery Promise.

When delivery has been effected, the cycle is complete, and the work of the department in connection with that particular order or contract is finished. But the mere ordering and securing delivery of supplies is but one part of the buying department's work. There is the examination and checking of materials delivered, a task of exceptional importance. Setting aside small deliveries by parcel post, there are only two ways in which goods can arrive at the works under discussion. One is by dray or other conveyance through the gates, and the other is by rail at the sidings. In both instances competent weighmen take a record of the weights of each truck load or consignment delivered. The work of distribution from the stores department to the various departments is complex, and will be dealt with in a later article.

On arrival of a consignment of goods, the storekeeper makes out a duplicate slip showing the order number—as ascertained from his own records—the weight and quantity, and the date of delivery. One of these he retains, and the other he despatches to the purchasing department. In the meantime, he examines for defects or damage such goods as he is competent to examine. In all other instances the buyer himself, or the departmental manager with the appropriate technical knowledge, examines the supplies. On receipt of the stores delivery ticket the necessary details are recorded on the cards, and the departments that requisitioned the supplies are notified of their arrival. The delivery tickets are then passed forward to the accounting department, as a double check on invoices.

In due course the supplier's invoice is received. The particulars on this are compared with the order, to ensure that the material is correct, the weight as ordered, and the price as arranged. It is then passed and initialled, and is also marked with the symbol of the department that originally ordered it. Then it follows the delivery ticket to the accounting department.

The methods of one existing foundry buying office have been summarised here because they are fairly typical of an efficient and not over-systematised department, and because a concrete example is always more valuable than a merely theoretical enunciation of principles. But it is essential that some consideration should be paid to the principles underlying each branch of foundry purchasing methods, and that the essential points to be borne in mind for each branch should be thoroughly understood.

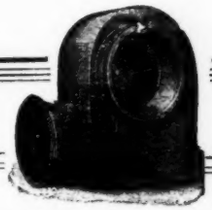
The Continental Steel Trust.

With reference to the international negotiations which are to take place in Paris on March 8 to 9, official invitations have been issued for the quarterly meeting of the Continental Steel Trust and the European Rail Makers' Association (Erma), but not for the discussion of the formation of selling syndicates. This, however, may not prevent discussions of this particular problem. The syndication of semi-finished steel and shapes in France marks a step forward in this direction, but there are no such organisations in Belgium. The momentary situation in the world market renders the question of selling syndicates less pressing for the Germans than it had been three months ago, as bars have advanced by about 12s. the ton as compared with the low price last autumn. Besides the more favourable export trade profits, the German producers have now the benefit of the reduced rebates to the finishing industries. This price development strengthens the position of the German industry in relation to the Western countries, which have lower wages to pay—their costs of production are said to be 30 per cent. lower than those in Westphalia—so that the necessity for making sacrifices in the allotment is to-day no longer so urgent as was perhaps the case at the end of last year.

As to the negotiations with the Polish works, which have been invited to the conference, it is considered uncertain whether these will lead to any definite result. In the case of the Central European group it is considered unlikely that their renewed request for an increase in their allotment has any prospect of being conceded, as, despite having exceeded its allotment, the group will presumably receive more from the equalisation fund than it has paid into it.

As to the meeting of the Erma, when British representatives will also be present, it is more than likely that a slight advance in the price of rails will be made.

Bessemer Gold Medal.—The Council of the Iron and Steel Institute has decided to award the Bessemer Gold Medal of the Institute for 1928 to Mr. Charles M. Schwab, of New York, chairman of the Bethlehem Steel Corporation and President of the American Iron and Steel Institute. It is expected that the Medal will be presented to Mr. Schwab in person by Mr. Benjamin Talbot (President of the Institute) at the Annual Meeting, at the Institution of Civil Engineers, on May 3.



40 Years' Experience in the Design and Construction of Fans

for

Heating and Ventilation of Buildings, Mines and Ships,
High Pressure Blast for Forges, Furnaces and Cupolas,
Mechanical Boiler Draught,
Fume and Steam Removal,
Dust Removal and Collection,
Cooling and Drying Plants.

means

Expert Knowledge, High Efficiency, Reliability and Good Service

Davidson's the TRADE SIROCCO MARK Fan Makers

have an experience covering hundreds of different industries and hundreds of different uses, and they can furnish a Sirocco Fan for every purpose for which a fan can be employed.

Solve your fan problems by using the Sirocco Service.

DAVIDSON & Co. LIMITED

SIROCCO ENGINEERING WORKS - BELFAST

London - Birmingham - Cardiff - Bristol - Manchester - Glasgow - Newcastle

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863.

JAS. DURRANS & SONS, LTD.

PHOENIX WORKS, PENISTONE, near SHEFFIELD.

Telephone :
21 PENISTONE.

Telegrams :
"DURRANS, PENISTONE."

Manufacturers of

FOUNDRY EQUIPMENTS

LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

Trade Talk.

A furnace has been put out of action at the Redcar Works.

Temple Thomson & Clark, Limited, 10 and 11, Lime Street, London, E.C.3, have removed to 8, Lloyd's Avenue, E.C.3.

The shareholders of the Templus Metal Company, Limited, have decided that the company be wound up voluntarily. Mr. B. R. McNaught, 88, Chancery Lane, W.C., has been appointed liquidator.

Another contract, which is the eighth since the company was formed last year, has been booked by the Northumberland Shipbuilding Company (1927), Limited, Howdon-on-Tyne, the vessel being a cargo boat of good size for Tyneside owners.

"The possibility of re-heating steel without the production of excessive smoke" was the subject discussed at the annual meeting of the Sheffield Society of Engineers and Metallurgists, at the Applied Science Department of Sheffield University, on February 20. Professor C. H. Desch (president) was in the chair.

It is announced that Sir W. G. Armstrong, Whitworth & Company, Limited, have secured a contract from the Great Western Railway Company for the supply of fifty 0-6-2 type superheated tank locomotives. These locomotives will be built at the Scotswood Works, and will be completed before the end of the year.

The undertaking of Padley and Price, Limited, has been acquired by Thos. Firth & Sons, Limited. The undertaking will in future be carried on as Thos. Firth & Sons (Birmingham), Limited. Messrs. Padley and Price's works have for the past three years been specially devoted to the manufacture of finished articles made from "Firth Staybrite" steel.

A tender of £38,653 by Dorman, Long & Company, Limited, of Middlesbrough, for track rails and bolts for the tramways has been accepted by London County Council on Tuesday. The tender of the Anglo-Belgian Steel Company, of Brussels, was £30,747, but the committee's recommendation to accept the British firm's tender, the next lowest, was made under one of the Standing Orders.

Mr. S. T. Coulson, of West Hartlepool, who recently purchased the North Shore shipyard at Stockton-on-Tees from the Ropner Shipbuilding and Repairing Company, Limited, has stated that, after careful consideration had been given to different proposals, it has been decided, owing to the difficulty of obtaining orders for ships, to dismantle the yard. The North Shore shipyard has stood idle since May, 1925.

It is stated that control of the Metropolitan-Vickers Electrical Company, which has an issued capital of £2,395,000, had passed from Vickers, Limited, to Mr. Frank Dudley Docker, chairman of the Electric & Railway Finance Corporation and a director of the Midland Bank, Metropolitan and Southern Railways, etc. Mr. Dudley Docker was chairman of the Metropolitan Carriage, Wagon & Finance Company before that business came under the control of Vickers, Limited.

A meeting has been convened by the Delta Metal Company, Limited, of London and Birmingham, to increase the capital by the issue of 42,000 ordinary shares of £1 each. It is proposed to offer them to shareholders in the proportion of one to every six held, at a premium of £1 10s. per share, payable 10s. per share on application, £1 on allotment and the remaining £1 on April 30 next. For the year 1927 the directors recommend a dividend of 12½ per cent. and bonus of 6d. a share (making 15 per cent. in all) free of tax, a further sum of £15,000 being placed to reserve and £16,198 being carried forward. The dividend for 1926 was 12½ per cent.

Mr. T. Metcalfe, of Newcastle-on-Tyne, presiding at the annual meeting of the North of England Association of Iron, Steel and Metal Merchants recently, said that at a recent meeting of their Council they discussed the steelmakers' rebate scheme, and it was suggested they should take steps to have merchants put on a more satisfactory footing. Continuing, Mr. Metcalfe observed: The manufacturers apparently have ignored the merchants altogether. The result is that merchants are concentrating on foreign material, which is not a good thing. Formerly the merchant was looked on as a very useful accessory to the manufacturer. He was able to scour the country, find new markets, and get orders, as well as occasionally to assist financially. To-day the merchant is almost looked on as a parasite, and steps have been taken to exclude him from handling goods. The expense of selling agencies is, he believed, more than the profits of the merchants. Touching on the trade situation generally, Mr. Metcalfe found conditions rather more refreshing than they were a year ago. There was certainly a greater volume of trade, though competition was still exceedingly keen. The demand had increased, and an expansion was anticipated

At the meeting of the boards of directors of British Empire Steel Corporation, Limited, Dominion Steel Corporation, Limited, Nova Scotia Steel & Coal Company, Limited, and their subsidiary companies, President Wolvin resigned, having succeeded in bringing into the affairs of the steel and coal industry of the Maritime Provinces new and influential financial and industrial interests. Mr. Wolvin expressed a belief that the complete severance of his connection with the affairs of these corporations might assist in ending litigation and facilitating reorganisation of the finances and properties of the companies. He further stated that his entire holdings of securities of Dominion Steel Corporation, Limited, and its subsidiary companies had been purchased by interests associated with Holt, Gundy & Company, who had also acquired 94 per cent. of the currency series of consolidated mortgage bonds of Dominion Iron & Steel Company, Limited, the guarantee of these bonds being practically the only indebtedness of Dominion Steel Corporation, Limited. Mr. C. B. McNaught was elected president of British Empire Steel Corporation, Limited, Dominion Steel Corporation, Limited, Nova Scotia Steel & Coal Company, Limited, and their subsidiary companies, and Sir Herbert S. Holt, Mr. J. H. Gundy, Mr. G. H. Duggan, Mr. W. E. Wilder, and Mr. G. H. Montgomery, K.C., were added to the boards of directors of the companies.

Speaking at a City luncheon of the Royal Colonial Institute last week, under the chairmanship of Lord Stanley of Alderley, Lord Askwith struck a warning note as to the shortage of the Empire's tin supplies. He said that this was a tin age. Tin was a commodity for which no satisfactory substitute had yet been found; nor, in his view, would it ever be successfully duplicated. As the population of the world had increased so the consumption of this metal had correspondingly progressed. The greatest amount of tin produced in a year was about 150,000 tons, and some 42½ per cent. was produced in the British Empire, but, thanks to Imperial Preference, over 80 per cent. of the world's tin was smelted in the Empire. Our national enterprise and foresight then had given us control of 42½ per cent. of the world's tin production, but by means of Imperial Preference, the Empire had obtained the virtual control of over 80 per cent. Fifty per cent. of the world's tin was consumed in the United States, for in 1914 the United States imported 43,000 tons of metallic tin, whereas in 1926 it imported 77,000 tons. The demand had increased 81 per cent., and yet the supply, with every price inducement, and with all the help of heavily subsidised scientific assistance, had increased only 36.6 per cent. The supply had been working very often regardless of the future and rapidly consuming its reserves of the future. In the last three years, output had exceeded 430,000 tons of metallic tin, and even with the extensive prospective activity which had characterised that period, barely one quarter of this very serious depletion had been replaced in the world's proved reserves. In other words we were using 150,000 tons of tin every year of the existing and irreplaceable reserves. The metallic tin consumption of the vast canning industry alone had nearly trebled itself in five years; that of the automobile industry had more than doubled in the same period. Tin would steadily increase in value as the years went on. Not only could they afford to ignore the temporary market fluctuations in the actual price of the metal, but they should assuredly do so, fortified as they were by the statistical records both of the price of the metal and the volume of the world production. He asked them to consider the fact that this great Imperial asset had a limited life, that it belonged to us, and it brought wealth to our nation. Last year it certainly brought not less than £20,000,000 sterling from America alone, and if a method could be found of conserving it, its value would surely and steadily increase, and we should thus possess a commodity which the whole world needed, and would demand in increasing proportion. There was a great need for a method to be evolved for conserving the Empire's tin supplies. It might be through the form of merging and trustification of all the existing British tin-producing companies, together with the chief smelting interests, thereby enabling them to obtain direct contact with the world's chief consumers to the great benefit of both. Such a method, confronted with difficulties though it might seem at first sight, had much to recommend it from the constructive point of view, and it was not impossible of achievement, for it would automatically bring about Empire conservation, whilst retaining the strong spirit of enterprise which was essential to this great industry. Another method which had been suggested, and which at the moment was receiving careful and considered examination, was co-operative selling, which had had great success in several industries.

Contracts Open.

Cairo, April 17.—Iron and steel materials, metals, etc., during 1928-29, for the Ministry of Communications, Ports and Lighthouses Administration. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference A.X. 5,940.)

Dover, March 7.—Iron and steel; steam, water and gas tubing and fittings, etc.; electric cables, etc.; wire rope, during year ending March 31, 1929, for the Dover Harbour Board. Mr. R. Mowll, register, Castle Street, Dover. (Fee 2s. 6d.)

Eden, Ireland, March 8.—Providing and laying 1,850 yds. of 4-in. cast-iron water pipe, together with the necessary valves, hydrants, fountains, etc., for the Larne Rural District Council. Mr. T. Nelson, clerk, Larne.

Fulwood, Lancs., March 7.—(1) 7,500 yds. of 10-in. cast-iron water mains, with valves and appurtenances, for the Urban District Council. Mr. G. J. Gibbs, engineer, 7, Lune Street, Preston. (Fee £2, returnable.)

Heywood, March 2.—Cast iron (manhole and ventilator covers, gully grids, etc.), for 12 months ending March 31, 1929, for the Corporation. Mr. J. B. Nuttall, borough surveyor, Heywood.

New Delhi, March 7.—(H. 3,324) 750 tons of spelter in slabs of 28 lbs., for the Indian Stores Department. The Department of Overseas Trade, 35, Old Queen Street, S.W.1.

Pontypridd, March 5.—Providing and laying 4,900 yds. of 14-in. diam. cast-iron pipes, together with the necessary valves, etc., for the Mid-Glamorgan Water Board. Messrs. Thomas & Morgan & Partners, engineers, Pontypridd. (Fee £5 5s., returnable.)

Sligo, March 6.—(1) 1,430 yds. of 3-in. cast-iron turned and bored piping, B.S.S., Class C; and (2) 130 yds. of 1-in. steel screwed and socketed piping, tested 20-lb. hydraulic pressure, for the Corporation. Mr. J. Shea, town clerk, Sligo.

Stoke-on-Trent, March 5.—(7) Cast-iron work, for six months ending September 30, 1928, for the Corporation. The City Surveyor, Town Hall, Stoke-on-Trent.

Personal.

Mr. Walter Piper, one of the inventors of the sand slinger, has been badly smashed up in an aeroplane accident at Sharron, Pennsylvania.

Mr. W. J. A. Butterfield has been elected chairman of the London Section of the Society of Chemical Industry, with Mr. C. S. Garland as vice-chairman.

Mr. William H. Nickolls, the president of the well-known American foundry equipment concern bearing his name, is at present in Europe arranging for the manufacture and distribution of moulding machines.

Mr. Charles Lyall Mason has been elected a director of Cammell, Laird & Company, Limited. He has also been elected managing director of the company's Sheffield and Penistone Works. Mr. Mason previously held the position of divisional carriage and wagon superintendent of the London Midland and Scottish Railway, and was in charge of the railway carriage and wagon shops of that company at Wolverton.

Company Meetings.

Lion Foundry Company, Limited.—At the annual meeting in Kirkintilloch the report stated that the profit for the year amounted to £7,769, and that the balance at the credit of profit and loss account was £17,053. The reserve fund stands at £22,500. A dividend of 8 per cent. on preference shares (in addition to a £5 per share bonus paid in July) and 10 per cent. on ordinary shares was declared.

Kerr, Stuart & Company, Limited.—Presiding at the seventeenth annual meeting, Mr. H. Langham Reed (chairman and managing director) said that the financial year under review included nearly five months of the coal dispute, during which period the company's works at Stoke-on-Trent were practically shut down owing to the difficulties experienced in obtaining raw material. To obtain work at profitable prices was at present almost an impossibility. There was considerably more work available than there had been, but there was as yet no sign of any improvement in prices. The capacity of the works manufacturing locomotives in this country was considerably greater than the volume of work available. The Peninsular Locomotive Company, having sold its works to the Indian Government—at whose invitation they were established—had liquidated its debt of approximately £90,000 to this company, and further negotiations were pending with the Government for compensation.

XUM

"SERVICE GRC FIRST"

ALL YOUR NEEDS IN REFRACTORIES AND MINERALS CAN BE AMPLY FILLED BY

The General Refractories Co. Ltd.

SHEFFIELD.

Enquiries are cordially invited and will be promptly and courteously answered. Expert technical advice on Refractological matters is offered free.

SANDS — GANISTER — FIREBRICKS — SILICAS — MAGNESITES — COROMA & CHROME BRICKS — FIRE CEMENTS—CORE BINDERS—COMPOSITIONS

ETC.

MONOMARK:

BCM/REFRACTORY LONDON.

Telegrams: Refractory, Sheffield. *Telephone: 22311 Sheffield.*

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—Business in the Cleveland market for foundry iron during the past week fully confirms the impression that the long-delayed improvement in trade conditions is at last within range of actual accomplishment, both as regards home and export transactions. Consumers are now convinced that they are not likely to get more favourable terms by waiting, and instead of buying from hand to mouth as heretofore, they are ordering for months ahead. Contracts to the end of June are common, and in one or two instances business has been done up to the end of the year. In the export section also a significant development recently has been the sale of 2,000 tons of Cleveland iron to Belgium, and a rather larger parcel to France. These orders, of course, are sufficiently substantial to represent a welcome addition to current business, but still more gratifying is the fact that Cleveland is once more in a position to sell iron to the two countries, which, for some considerable time past, have been Cleveland's most formidable competitors. Stocks of iron in makers' yards are about exhausted, and, should the present rate of disposal be maintained, means will have to be taken to increase furnace production. In the meantime quotations are firmly held as follow: No. 1 Cleveland foundry iron, 67s. 6d. per ton; No. 3 Cleveland G.M.B., 65s.; No. 4 foundry, 64s.; No. 4 forge, 63s. 6d. per ton.

The hematite market continues irregular, but it would need only a slight stimulus to move prices upwards. The market has been flat and unprofitable for some weeks past, and between East and West Coast producers there has been keen competition. The East Coast makers now quote 70s. per ton for mixed numbers and 70s. 6d. for No. 1 quality. North-West Coast quality is priced at the same level.

LANCASHIRE.—As far as pig-iron markets are concerned, the local foundries are not buying very freely, and of the orders that have been reported recently, those for important quantities spread over the next few months have been exceptional and certainly very few in number. Prices, however, remain fairly steady, quotations ruling:—Staffordshire, 71s. 6d. per ton; Derbyshire No. 3, 72s. 3d.; Lincolnshire, 71s. to 71s. 6d.; with Scottish brands from 86s. per ton to 87s. 6d., all delivered Manchester or equal.

THE MIDLANDS.—Local demand for foundry pig continues on a limited scale, prices, however, remaining steady at about previously quoted levels. Derbyshire No. 3 is on offer at furnaces at 64s., Northamptonshire 60s., North Staffordshire No. 3 64s. to 65s., Lincolnshire 72s. 6d. delivered, and No. 3 Scotch 90s. per ton delivered.

SCOTLAND.—Little improvement is reported in conditions in the Scottish iron, for which inquiry continues moderate. The quotation for No. 3 foundry pig-iron remains unchanged at 70s. f.o.r. at the furnaces. There is no increase in the demand at present, although at some points Scottish iron is more competitive against English iron, and, with Continental iron no longer offered at a price which is workable, the whole tendency at the moment is for an increased demand for the home products.

Finished Iron.

Conditions in this section of the iron trade continue flat, with many mills and forges in the Black Country reporting only partially filled order books. Crown quality bars are quoted from £9 5s. per ton, but orders representing any tonnage are entirely absent. There is keen competition for what little business is developing. The South Staffordshire price for nut and bolt iron is about £9, and Belgian No. 3 is offered at £6 2s. 6d. to £6 5s., delivered works in this area. The makers of Staffordshire marked bars continue to be fairly well occupied, the fixed price being £12 10s. at makers' works. Values of Lancashire bar iron are well held at £10 per ton for crown quality and £9 10s. for seconds material, with merchant parcels of the former still offering on the basis of 14s. per cwt., less 2½ per cent. and including delivery to consumers' works.

Steel.

On the whole, slightly more favourable views on the outlook of the British steel industry appear to prevail in the principal markets, although some manufacturers still report an irregular demand, and generally quiet conditions. There has been a revival of buying of semi-finished steel, although most of the orders appear to have gone to Continental works. Nevertheless, British manufacturers are benefiting from the advance in Continental quotations, particularly in the Midlands. At Sheffield there is also expectation of increased activity at an early date, in view of the advances in quotations for imported steel. There is a quiet demand for acid and basic billets. The revision of wire rod prices is proving helpful to business, and all round there is a better tone about the market. Billet prices are:—Siemens acid, £10; soft basic, £6 10s.; hard, £8 2s. 6d. Soft wire rods are down to £7 15s. Special steel output is growing week by week, but production of open-hearth and the cheaper makes of steel shows a considerable falling away.

Scrap.

Values of most classes of foundry metal scrap material continue to vary according to locality and the volume of local demand. At Middlesbrough, for example, buyers are now paying 66s. per ton for heavy machinery cast iron, but the demand for this, and also for ordinary quality, at 62s. per ton is limited. On the other hand, supplies of cast-iron borings at 43s. per ton probably exceed the demand. In Scotland, although business is quiet, machinery cast-iron scrap is still firm around 70s. per ton for pieces not exceeding 1 cwt., and for ordinary heavy cast iron to the same specification 5s. per ton less. Steelworks cast-iron scrap in furnace sizes is firm at 62s. 6d. to 65s. per ton; old cast-iron chairs are on offer at 67s. 6d. to 70s. per ton, and light cast-iron scrap at 57s. 6d. to 60s. per ton, with old cast-iron firebars at about 55s. per ton. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Although fluctuations in values during the past week were inclined to slightly lower levels, the general tone of the warrant copper market remains fairly steady in tendency, with only a moderate demand on the part of consumers at home, counterbalanced to some extent by more favourable American advices. The electrical branch in this country, which had been so prosperous within the last few years, is still passing through a quiet period, with orders from that quarter coming forward in decreased volume, while this industry in Germany likewise is not so active as it was.

Official closing prices of standard copper have been as follow:—

Cash: Thursday, £61 1s. 3d. to £61 2s. 6d.; Friday, £60 17s. 6d. to £60 18s. 9d.; Monday, £60 17s. 6d. to £60 18s. 9d.; Tuesday, £60 16s. 3d. to £60 17s. 6d.; Wednesday, £60 11s. 3d. to £60 12s. 6d.

Three Months: Thursday, £60 16s. 3d. to £60 17s. 6d.; Friday, £60 12s. 6d. to £60 13s. 9d.; Monday, £60 12s. 6d. to £60 13s. 9d.; Tuesday, £60 11s. 3d. to £60 12s. 6d.; Wednesday, £60 6s. 3d. to £60 7s. 6d.

Tin.—With some abatement of recent bear pressure, the values of standard cash tin, it is satisfactory to report, are now holding better. At the lower levels there has been some moderately good buying, but sellers, nevertheless, met the demand with freedom, and the close was but little above the worst. It is difficult at the moment to form an idea how far the bear campaign may be persevered with, but there seems to be a strong impression that the depression is being overdone, while it is well to bear in mind that there has been a very heavy fall in imports since the beginning of this year, which should have discounted prospects of increased supplies.

Official closing prices of standard tin have been as under:—

Cash: Thursday, £227 17s. 6d. to £228; Friday, £230 5s. to £230 10s.; Monday, £232 15s. to £233; Tuesday, £231 5s. to £231 10s.; Wednesday, £229 to £229 5s.

Three Months: Thursday, £230 10s. to £230 15s.; Friday, £232 15s. to £233; Monday, £235 2s. 6d. to £235 5s.; Tuesday, £233 17s. 6d. to £234; Wednesday £231 15s. to £232.

Spelter.—The market for ordinary spelter of late has been inclined to harden under the influence of better reports regarding the galvanised sheet trade. In view of the fact that the December average daily output (4,091 short tons) is the highest of last year, it must be obvious that, despite the dulness of the market, consumption is expanding, maybe slowly, but none the less surely, and apparently at a sufficient rate to keep pace with the increasing production.

The following are the week's prices:—

Ordinary: Thursday, £25; Friday, £25; Monday, £25 2s. 6d.; Tuesday, £25 2s. 6d.; Wednesday, £25 2s. 6d.

Lead.—The position in the market for soft foreign pig is unsettled, values having fallen away again to a low level, in consequence of liquidation and consumers' limited buying in the face of continued liberal arrivals, but users are poorly supplied, which should lead to an early revival of demand. At the moment consumptive demand in the U.K. is still hanging fire, and Continental advices are not very bright, but there should be an improvement in this respect before long—meantime the outlook is not very promising.

The week's prices are appended:—

Soft foreign (prompt): Thursday, £20; Friday, £19 18s. 9d.; Monday, £20 5s.; Tuesday, £19 17s. 6d.; Wednesday, £19 12s. 6d.

Publications Received.

Pitman's Dictionary of Industrial Administration. Edited by John Lee, C.B.E., M.A., M.Com. (Sc.), London: Sir Isaac Pitman & Sons, Limited. Complete in 30 fortnightly parts, each part 1s. 3d. net each.

A glance at Part I of "Pitman's Dictionary of Industrial Administration" is sufficient to convince us that this new science has been treated in a bigger and more comprehensive way than has ever been known before. The contents of the work are such that the publishers have decided to issue it in 30 fortnighly parts of 48 pages. The object of the work is to provide a complete encyclopædia of modern facts regarding industrial administration, factory organisation and business management. Its contributors number over 100 eminent specialist writers, drawn from every department of industrial activity, and under the general editorship of Mr. John Lee, C.B.E., M.A., M.Com. (Sc.).

Record Breaking and Engine Parts.

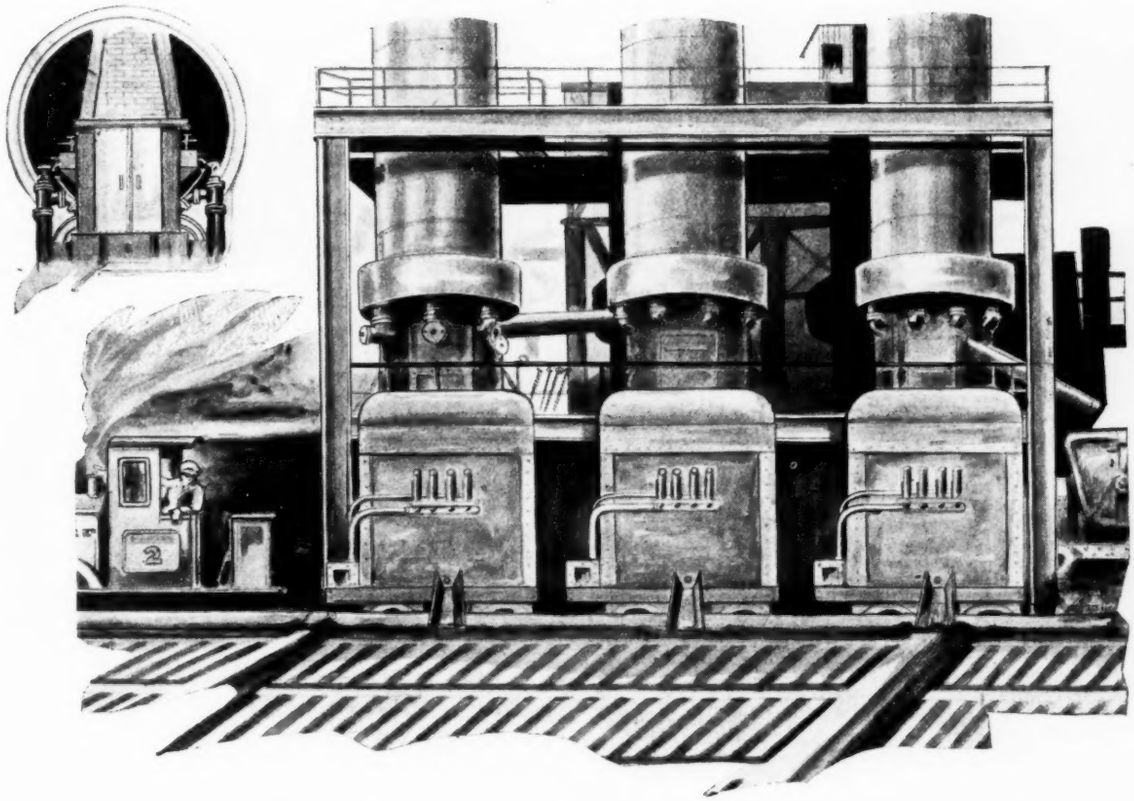
Captain Malcolm Campbell in achieving a speed of 206.9 miles an hour in his Napier-Campbell "Blue Bird" motor car has established a world's record. In this, as in most of the recent record-breaking achievements on land and in the air, Vickers' steels have played their part. The frame, axles, gears, the steel forgings in the gear box, and the crankshaft and connecting rod drop forgings were of Vickers' steel and manufacture, being products of the River Don Works of Messrs. Vickers-Armstrongs, Limited.

It is interesting to note that Vickers' steels were also used in Major Segrave's famous Sunbeam car, with which he achieved a speed of 203.841 m.p.h., and in the victorious Bentley car, in the 24 Hours' Grand Prix d'Endurance at Le Mans. The crankshaft and connecting rod drop forgings of the Napier "Lion" engine fitted to the Supermarine Napier S.5, which won the Schneider Trophy race for Great Britain, were likewise of Vickers' steel and manufacture, as was also the crankshaft of the A.C. car, with which the Hon. Victor and Mrs. Bruce averaged over 68 m.p.h. for 15,000 miles on the Montlhery course at Paris.

The American foundry designers, Messrs. Frank D. Chase, Inc., have received a contract to construct a grey iron foundry at Podolsky, a suburb of Moscow. It is to have an annual capacity of 150,000 tons of sewing machine castings.

Mr. R. de Vancorbeil, works manager of Messrs. Guillet, Sons & Company, of Auxerre, France, is to present a paper next Saturday to the French Foundrymen's Association on "The Development of Mechanical Equipment in Modern Foundries."

XUM



Modern methods in the making of Refined Pig Iron

Carrying on the traditions of their progenitors, Bradleys are to-day still producing Refined Pig Iron for purposes where quality is the first consideration.

The old type Refinery hearth has passed into the limbo of the past, and present day requirements are amply fulfilled by the most up-to-date methods worked by modern plant.

Bradley products are the result of careful and continued research, and the greatest skill and metallurgical knowledge is employed in supplying iron to the closest limits of composition. High duty castings can only be produced satisfactorily by looking within these close limits.

Foundry Trade Journal,
Dec. 29th, 1927.

"Low Total Carbon, which is usually reflected in small size graphite, along with suitable balance of composition, yields a high grade Iron with valuable physical characteristics, which make it very suitable for the manufacture of a number of castings for which modern engineering has given the demand."

W. DENNISON.

Bradley's

PIG IRON

"A QUALITY FOR EVERY REQUIREMENT"

Write us for particulars of our Low Total Carbon Irons, produced specially for high duty castings.

BRADLEY & FOSTER LTD (BF) DARLASTON, STAFFS.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	60 11 3
Three months	60 6 3
Electrolytic	66 0 0
Tough	64 5 0
Best selected	64 15 0
Sheets	92 0 0
India	76 0 0
Wire bars	66 10 0
Do. March	66 10 0
Do. April	66 10 0
Ingot bars	66 10 0
H.C. Wire rods	71 0 0
Off. av. cash, Jan.	61 18 11 1/32
Do. 3 mths., Jan.	61 15 0 15/32
Do., Sttlmnt., Jan.	61 18 10 4/11
Do., Electro, Jan.	66 16 1 7/11
Do., B.S., Jan.	66 4 8 5/11
Aver. spot price, copper, Jan.	61 18 11
Do., Wire bars, Jan.	67 1 1 1/2
Solid drawn tubes	13d.
Brazed tubes	13d.
Wire	9 1/2d.

BRASS.

Solid drawn tubes	11 1/2d.
Brazed tubes	13 1/2d.
Rods, drawn	10 1/2d.
Rods, extd. or rlld.	7 1/2d.
Sheets to 10 w.g.	10 1/2d.
Wire	9 1/2d.
Rolled metal	9 1/2d.
Yellow metal rods	7 1/2d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8 1/2d.

TIN.

	£ s. d.
Standard cash	229 0 0
Three months	231 15 0
English	234 10 0
Bars	238 10 0
Straits	235 10 0
Australian	232 0 0
Eastern	238 2 6
Banca	235 10 0
Off. av. cash, Jan.	253 6 5 1/32
Do., 3 mths., Jan.	252 5 1 1/11
Do., Sttlmt., Jan.	253 6 4 5/11
Aver. spot, Jan.	253 6 5

SPELTER.

	£ s. d.
Ordinary	25 2 6
Remelted	25 0 0
Hard	19 15 0
Electro 99.9	29 10 0
English	25 10 0
India	21 5 0
Zinc dust	33 0 0
Zinc ashes	8 0 0
Off. aver., Jan.	26 1 9 3/32
Aver., spot, Jan.	26 2 6

LEAD.

	£ s. d.
Soft foreign ppt.	19 12 6
English	21 0 0
Off. average, Jan.	21 19 10 13/14
Average spot, Jan.	21 15 5 1/2

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	35 0 0
Do. V.M. ex whf.	32 15 0
Rods	41 15 0
Boiler plates	30 10 0
Battery plates	32 0 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	64 10 0
Chinese	44 10 0
Crude	36 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	20 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 15 0
45/50%	£12 17 6
75%	£20 10 0
Ferro-vanadium—	
35/40%	14/3 lb. va.
Ferro-molybdenum—	
70/75% c. free	4/11 lb.
Ferro-titanium—	
23/25% carbonless	11d.
Ferro-phosphorus, 20/25%	£17 15 0
Ferro-tungsten—	
80/85%, c. fr.	1/3 lb.
Tungsten metal powder—	
98/99%	1/7 1/2 lb.
Ferro-chrome—	
2/4% car.	£32 15 0
4/6% car.	£22 10 0
6/8% car.	£22 7 6
8/10% car.	£22 5 0
Ferro-chrome—	
Max. 2% car.	£35 5 0
Max. 1% car	£41 10 0
Max. 0.70% car	£52 0 0
70%, carbonless	1/2 lb
Nickel—99%, cubes or pellets	£175 0 0
Ferro-cobalt	9/6 lb.
Aluminium 98/99%	£105 0 0
Metallic chromium—	
96/98%	2/11 lb.
Ferro-manganese (net)—	
76/80%, loose	£13 10 0
76/80%, packed	£14 10 0
76/80%, export	£13 5 0
Metallic manganese—	
94/96%, carbonless	1/10 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 6
Finished bars, 18% tungsten	£0 3 0

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/2 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 1/16 in.	1/- lb.
Flats, 1/2 in. × 1/4 in. to under 1 in. × 3/4 in.	3d. lb.
Do., under 1/4 in. × 1/4 in.	1/-lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£ s. d.
South Wales—	
Hvy. steel	3 1 0 to 3 2 6
Bundled steel and shrngs.	2 15 0 to 3 0 0
Mixed iron and steel	2 15 0 to 2 16 6
Heavy cast iron	3 0 0
Good machinery for foundries	3 2 6 to 3 5 0
Cleveland—	
Heavy steel	2 15 0
Steel turnings	2 8 6
Cast iron borings	2 3 0
Heavy forge	3 10 0
Bushelled scrap	3 2 6
Cast-iron scrap	3 2 0 to 3 6 0
Lancashire—	
Cast-iron scrap	3 5 0
Hvy. wrought	3 2 6
Steel turnings	2 2 6
London—Merchants' buying prices delivered yard.	
Copper (clean)	52 0 0
Brass (clean)	38 0 0
Lead (less usual draft)	18 0 0
Tea lead	16 0 0
Zinc	16 0 0
New aluminium cuttings	75 0 0
Braziery copper	47 0 0
Gunmetal	48 0 0
Hollow pewter	165 0 0
Shaped black pewter	125 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	67/6
Foundry No. 3	65/-
Foundry No. 4	64/-
Forge No. 4	63/6
Hematite No. 1	70/-
Hematite M/Nos.	69/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	83/6
,, d/d Birm.	87/6
Midlands—	
Staffs. common*	—
,, No. 4 forge	62/6
,, No. 3 fdry.	64/-
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	—
,, fdry. No. 3	60/-
Derbyshire forge	60/-
,, fdry. No. 3	64/-
,, basic	—
Scotland—	
Foundry No. 1	—
,, No. 3	70/-
Hem. M/Nos.	73/6
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	67/6
Lincs. forge	64/-
,, fdry. No. 3	67/-
E.C. hematite	82/6
W.C. hematite	85/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	72/3
Northants foundry No. 3	—
Dalzell, No. 3	100/- to 102/6
Summerlee, No. 3	87/6 to 94/-
Glengarnock, No. 3	87/6 to 94/-
Gartsherrie, No. 3	87/6 to 94/-
Monkland, No. 3	87/6 to 94/-
Coltness, No. 3	87/6 to 94/-
Shotts, No. 3	87/6 to 94/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d.	£ s. d.
Iron—		
Bars (cr.) nom.	9 5 0 to	10 10 0
Angles	—	
Tees to 3 united ins.	—	
Nut and bolt iron	9 0 0	
Hoops	12 0 0	
Marked bars (Staffs.) f.o.t.	12 10 0	
Gas strip	12 0 0	
Bolts and nuts, 3/4 in. × 4 in.	15 5 0	
Steel—		
Ship plates	8 7 6 to	8 12 6
Boiler plts.	10 10 0	
Chequer plts.	10 5 0	
Angles	7 17 6	
Tees	8 17 6	
Joists	7 17 6	
Rounds and squares, 3 in. to 5 1/2 in.	7 10 0	
Rounds under 3 in. to 3/4 in. (Untested)	7 15 0 and upwards	
Flats, over 5i n. wide and up	8 17 6	
Flats, 5 in. to 1 1/2 in.	7 17 6	
Rails, heavy	8 2 6 to	8 7 6
Fishplates	12 10 0	
Hoops (Staffs.)	10 10 0	
Black sheets, 24g.	9 17 6	
Galv. cor. shts., 24g.	13 5 0	
Galv. fencing wire 8g. plain	12 10 0	
Billets, soft	£6 0 0 to	6 10 0
Billets, hard	8 2 6	
Sheet bars	£5 12 6 to	5 15 0
Tin bars	£5 12 6 to	5 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2 1/2
Sheet to 10 w.g.	1 3
Wire	1 3 1/2
Rods	1 3
Tubes	1 8 1/2
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3 1/2 to 1/9 1/2
To 15 in. wide	1/3 1/2 to 1/9 1/2
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4 1/2 to 1/10 1/2
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5 1/2
Ingots rolled to spoon size	1/- to 1/8 1/2
Wire round—	
3/0 to 10 G.	1/6 1/2 to 2/1 1/2

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.76
No. 2 foundry, Valley	17.25
No. 2 foundry, Birm.	16.00
Basic	18.76
Bessemer	19.26
Malleable	19.01
Grey forge	18.51
Ferro-mang. 80% d/d	100.00
Bess rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.90
Sheets, galv., No. 24	3.65
Sheets, blue an'l'd., 9 and 10	2.10
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham and North.	
,, foundry	—
,, furnace	14/-
Other Districts, foundry	—
,, ,, furnace (basis)	12/- to 13/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14	box	17/10 1/2
,,	28×20	,,	35/9
,,	20×10	,,	—
,,	18 1/2×14	,,	—
C.W.	20×14	,,	17/-
,,	28×20	,,	—
,,	20×10	,,	—
,,	18 1/2×14	,,	—
Terneplates	28×20	—	per box basis f.o.b.

SWEDISH IRON.

Bars, hammered,	£17 10 0 to £18 10 0
Rolled Ord.	£15 0 0 to £15 10 0
Nail rods	£15 7 6 to £15 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£8 to £12
Pig-iron	£5 15 0 to

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	Fittings.
Gas	67½%	45%
Water	63½%	40%
Steam	60%	35%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£ s. d.	
Feb. 23 ..	61 1 3	dec.	2/6
,, 24 ..	60 17 6	,,	3/9
,, 27 ..	60 17 6	No change	
,, 28 ..	60 16 3	dec.	1/3
,, 29 ..	60 11 3	,,	5/-

Electrolytic Copper.

	£ s. d.	
Feb. 23 ..	66 5 0	No change
,, 24 ..	66 5 0	,, ,,
,, 27 ..	66 5 0	,, ,,
,, 28 ..	66 0 0	dec. 5/-
,, 29 ..	66 0 0	No change

Standard Tin (cash).

	£ s. d.		
Feb. 23 ..	227 17 6	dec.	7/6
,, 24 ..	230 5 0	inc.	47 6
,, 27 ..	232 15 0	,,	50/-
,, 28 ..	231 5 0	dec.	30/-
,, 29 ..	229 0 0	,,	45/-

Tin (English ingots).

	£ s. d.		
Feb. 23 ..	232 0 0	inc.	5/-
,, 24 ..	234 10 0	,,	50/-
,, 27 ..	237 0 0	,,	50/-
,, 28 ..	236 10 0	dec.	10/-
,, 29 ..	234 10 0	,,	40/-

Zinc Sheets (English).

	£ s. d.	
Feb. 23 ..	35 0 0	No change
,, 24 ..	35 0 0	,, ,,
,, 27 ..	35 0 0	,, ,,
,, 28 ..	35 0 0	,, ,,
,, 29 ..	35 0 0	,, ,,

Spelter (ordinary).

	£ s. d.		
Feb. 23 ..	25 0 0	No change	
,, 24 ..	25 0 0	,,	,,
,, 27 ..	25 2 6	inc.	2/6
,, 28 ..	25 2 6	No change	
,, 29 ..	25 2 6	,,	,,

Lead (English).

	£ s. d.		
Feb. 23 ..	21 5 0	inc.	5/-
,, 24 ..	21 5 0	No change	
,, 27 ..	21 10 0	inc.	5/-
,, 28 ..	21 5 0	dec.	5/-
,, 29 ..	21 0 0	,,	5/-

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895 ..	2 3 0	2 3 0	2 2 6	2 2 6	2 2 6	2 4 0	2 3 6	2 4 0	2 5 0	2 5 6	2 6 6	2 5 6	2 3 11½
1896 ..	2 5 6	2 6 0	2 6 0	2 6 0	2 6 0	2 5 6	2 5 0	2 5 0	2 5 0	2 6 0	2 7 0	2 8 6	2 5 11½
1897 ..	2 10 0	2 11 0	2 9 0	2 8 6	2 8 0	2 7 0	2 7 0	2 6 0	2 6 0	2 6 0	2 6 6	2 7 6	2 7 9½
1898 ..	2 7 6	2 8 0	2 8 0	2 8 0	2 8 6	2 10 0	2 10 0	2 10 0	2 10 0	2 11 0	2 14 0	2 14 0	2 9 11
1899 ..	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 0	3 6 2½
1900 ..	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901 ..	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902 ..	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6	2 17 6	2 17 6	2 17 1½
1903 ..	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904 ..	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905 ..	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906 ..	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907 ..	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908 ..	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12 6	2 12 6	2 13 5½
1909 ..	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910 ..	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911 ..	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8½
1912 ..	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913 ..	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914 ..	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2½
1915 ..	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916 ..	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917 ..	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918 ..	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919 ..	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920 ..	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1½
1921 ..	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 16 10	8 0 2
1922 ..	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 10 0	4 13 7½
1923 ..	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924 ..	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925 ..	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926 ..	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1927 ..	4 13 9½	4 13 3	4 11 1½	4 9 4½	[4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6½
1928 ..	3 13 2½	3 12 3½	—	—	—	—	—	—	—	—	—	—	—

* No prices available during strike period.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

LIMPET

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY FOREMAN wanted for Midlands in Iron Foundry, casting 5-10 tons per day, used to repetition work; must be fully experienced in hand and power moulding machines and plate work; also good-class general jobbing work, weighing from a few lbs. to 3 tons. —Reply, stating full particulars of experience, age, and salary required, to Box 646, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN wanted, to take charge and reorganise Iron Foundry in the Midlands.—Box 652, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED, experienced Green and Dry Sand Moulders; steady work at piece-work rates for good men.—Apply Ealing Park Foundry, Ltd., Junction Road, South Ealing, W.5.

MACHINERY.

WANTED, Second-hand 400-lb. Morgan Tilting Type A Furnace, coke fired.—Offers to Box 642, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

WANTED, two No. 2 Britannia Jar-Ram Moulding Machines, one Sand Mixer, one Cupola.—Particulars, condition and price to Box 616, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

ONE TWO-TON CUPOLA, 2 ft. 6 in. shell, Roper No. 2, high efficiency, with motor-driven fan, nearly new; Sand Mixer and Oil Sand Mixer; Gas-fired Core Stove; three Hand-operated Moulding Machines.—Box 638, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PAIR OF MODERN BONVILLAIN HYDRAULIC MOULDING MACHINES for Sale; one R3, one A3; take boxes 24 in. dia.; practically new; £120 the pair.—Box 628, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. Brealey & Company, Limited, Prospect Works, Hawksley Avenue, Sheffield.

FOUNDRY PLANT FOR SALE CHEAP.

Two 25-ton Travelling Cranes, each 42-ft. span, and each with 4 electric motors and light lift of 5 tons, by Sir W. Arrol.

One 10-ton Electric Travelling Crane, 50-ft. span, with 3 electric motors, tramway type controls, 352-ft. sectional steel girder runway.

One 10-ton Travelling Crane, 27-ft. span, with hand-operated carriage on pitch pine gantry, steel rails, and 14 heavy C.I. stancheons.

Three Cupolas, 3-, 5- and 10-ton capacities.

Two single-geared Rattler Boxes.

Nine geared metal Ladles, capacities 30 cwt. to 20 tons.

Table Moulding Machine, with pneumatic rammer.

32-h.p. D.C. Electric motor (Phœnix), complete.

Three Jackman Pneumatic Jarring Machines.

C.I. Core Barrel, 8-ft. long by 4-ft. dia.

Contents Laboratory, various patterns, moulding boxes, new shank ladles, chains and other effects.

Offers wanted to clear.

Blythe & Berwick, Limited,
23, Charles Street, Bradford. Tel.: 6474.

MACHINERY.—*Continued.*

BARGAIN.—Practically new Plant by Pneulec Company; only done two months' work.

Electrically-operated Jar Ram Moulding Machine, with motor, up to 12-cwt. castings.

P.M.-type Oil Sand Mixer, with hopper.

No. 4 Gas-fired Core Stove, with thermometers.

P.-type Tamper Moulding Machine.

Also Moulding Boxes for 12-ton new specification wagon axle boxes.

Core Plates and Boxes, etc.

Must be cleared.—Box 644, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY PLANT, &c., FOR SALE.

PRATT & WHITNEY 14-in. Vertical Surface Grinder.

WILMARTH & MORMON Heavy Twist Drill Grinding Machine.

WILKINSON Automatic Rack Gear-Cutting Machine.

LUDW LOEWE No. 20 Tool and Cutter Grinder.

STONE BREAKERS, from 10 in. x 6 in. x 30 in. x 18 in. size; overhauled; ready for work.

CONCRETE MIXERS, steam, petrol and belt driven, from 4 cubic feet to 1 cubic yard capacity; ready for work.

Two first-class land-type W.I.F. WATER-TUBE BOILERS, by Babcock & Wilcox, Ltd., each with heating surface of 4,780 square feet, and approximate evaporation 19,000 lbs. of water per hour; reinsurable at a working steam pressure of 200 lbs. per square inch, with Superheater, chain grate stokers and steam fittings.

Two LANCASHIRE BOILERS, 30 ft. x 8 ft.; reinsure 110 lbs. pressure.

About 14 8 in. diameter cast-iron Spigot and Socket Pipes, each 9 ft. 3 in. long.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD LTD.,
ALBION WORKS, SHEFFIELD.

PATENTS AND TRADE MARKS.

INFORMATION HANDBOOKS. Advice, and Cons. free; King's Patent Agency, Ltd.—B. T. King, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146a, Queen Victoria Street, E.C.4. 40 years' refs. 'Phone: 0682 Central.

THE PROPRIETOR of the Patent No. 163,543, for "Improvements in Rotary Furnaces," is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Co., Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

PROPERTY.

FOUNDRY FOR SALE, as a going concern; substantial brick building; site, 3 acres; floor area, 24,000 ft.; on Main Line, with siding; 35 miles from London.—Apply Box 632, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

11 ACRES WORKS SITE,
SHEFFIELD.
145,000 Sq. Ft. of SHOPPING,
Compact and Convenient.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES
Will Sell whole or in lots to suit customers, or Let on favourable terms. Unique opportunity for Manufacturers.
Apply—
THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

SMALL Handy Foundry in North-East Scotland for Sale; price £2,000.—Apply, Box 650, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PARTNERSHIP.

PROPRIETOR of Marine and General Engineering Works, complete with Foundry, having waterside facilities situated on Thames within easy distance of London, desires Working Partner with capital, to enable purchase of the freehold of present premises; business in same hands 20 years; good investment for anyone able to introduce specialities; or would sell outright as going concern.—Apply Box 648, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

FOUNDRY, continuously purchasing Metal Patterns, desires further suppliers.—Apply Box 640, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

MAUGHLIN PATTERN LETTERS AND FIGURES.—Die cast complete with pins in one piece, ready for fixing; no shellac required; simply drive them in and they will not come off; send for samples and prices.—A. Lakin & Son, Totley Rise, Sheffield.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—Cleghorn & Company, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264.

CHARCOAL.—Powdered, granulated, lump, blacking; inquiries invited.—J. Buchanan & Company, Ashfield Road, Altrincham, Cheshire.

WILLIAM OLSEN, LIMITED, HULL, beg to inform recipients of their 1928 Catalogue (and all others interested) that a new list of Moulders' Brush Goods, containing a number of reduced prices, has since been issued, and will be posted on application.

WANTED, "Foundry Trade Journal," 1902 to 1923; complete set or odd volumes. —Kindly write, giving full particulars, to Wm. Dawson & Sons, Ltd. (Booksellers), Second-hand Dept., Cannon House, Bream's Buildings, London, E.C.4.

ERITH YELLOW LOAM and SAND
FINEST QUALITY.

Quoted F.O.R. or D/D. to Customer's Station. *Enquiries esteemed.*

H & E. CRUNDALL, LTD.,
Foundry Supplies Dept.,
52, COAL EXCHANGE, LONDON, E.C.3.
Also
COKE and ALL FOUNDRY MATERIALS.

'Phone: 287 SLOUGH.

CRANE LADLES

½ TON (NEW), enclosed gear ..	£12
1 TON (NEW), enclosed gear ..	£20
5 TON EVANS, as new	£36
8 TON EVANS, good	£40
10 TON STEVENSON, equal to new	£45
12 TON EVANS, equal to new ..	£65
15 TON STEVENSON as new ..	£80

All have Worm and Bevel Gear.

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS

BUY FROM ME AND SAVE MONEY.

Alex. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH.